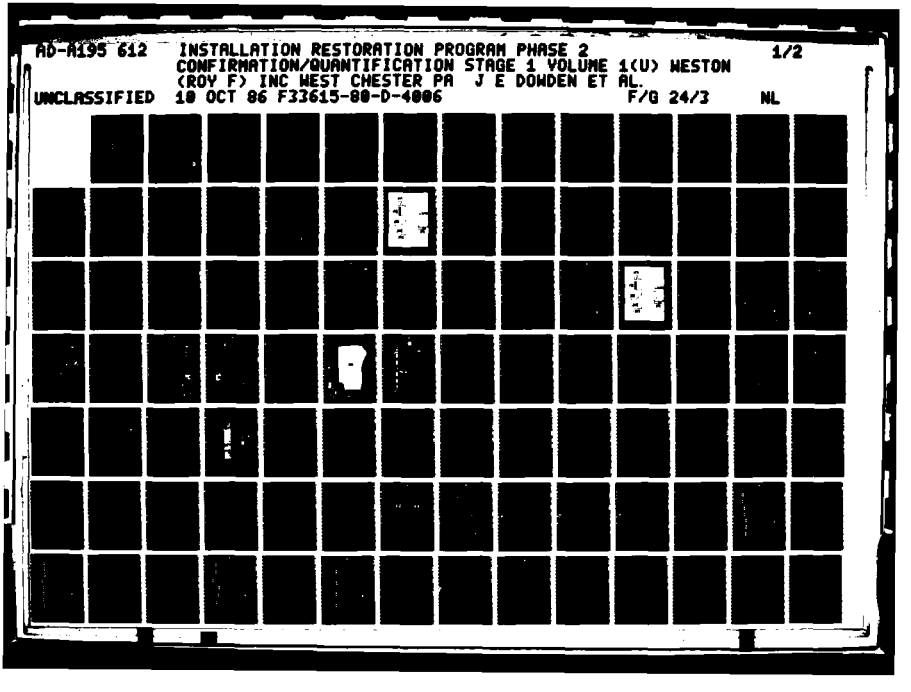
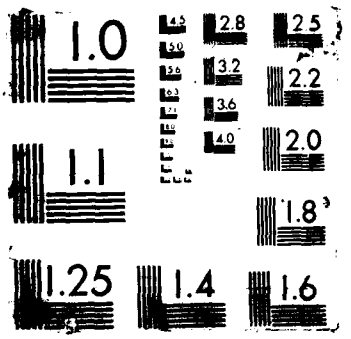
AD-A195 612 INSTALLATION RESTORATION PROGRAM PHASE 2 CONFIRMATION/QUANTIFICATION STAGE 1 VOLUME 1(U) WESTON (ROY F) INC WEST CHESTER PA J E DOWDEN ET AL. 1/2

UNCLASSIFIED 10 OCT 86 F33615-80-D-4006 F/G 24/3 NL




1.0
1.1
1.25
1.4
1.6
1.8
2.0
2.2
2.5
2.8
3.2
3.6
4.0
4.5
5.0
5.6
6.3

INSTALLATION RESTORATION PROGRAM PHASE II - CONFIRMATION/QUANTIFICATION STAGE 1

VOLUME I

Selfridge Air National Guard Base
Macomb County, Michigan

Roy F. Weston, Inc.
West Chester, Pennsylvania 19380

OCTOBER, 1986

FINAL REPORT FOR PERIOD NOVEMBER 1984 TO OCTOBER 1986

PREPARED FOR:

AIR NATIONAL GUARD SUPPORT CENTER
OFFICE OF THE AIR SURGEON (ANGSC/SGB)
ANDREWS AIR FORCE BASE, MARYLAND 20331-6008

UNITED STATES AIR FORCE
OCCUPATIONAL & ENVIRONMENTAL HEALTH LABORATORY (USAFOEHL)
BROOKS AIR FORCE BASE, TEXAS 78235-5501

INSTALLATION RESTORATION PROGRAM

PHASE II - CONFIRMATION/QUANTIFICATION
STAGE 1

VOLUME I

FINAL REPORT

FOR

SELFRIDGE AIR NATIONAL GUARD BASE
MACOMB COUNTY, MICHIGAN

AIR NATIONAL GUARD SUPPORT CENTER
ANDREWS AIR FORCE BASE, MARYLAND 20331-6008

OCTOBER, 1986

PREPARED BY

ROY F. WESTON, INC.
WEST CHESTER, PENNSYLVANIA 19380

USAF CONTRACT NO: F33615-80-D-4006, DELIVERY ORDER: 49
CONTRACTOR CONTRACT NO: F33615-80-D-4006, DELIVERY ORDER 49

USAFOEHL TECHNICAL PROGRAM MANAGER
CAPT. ROBART W. BAUER

USAF OCCUPATIONAL AND ENVIRONMENTAL
HEALTH LABORATORY (USAFOEHL)
TECHNICAL SERVICES DIVISION (TS)
BROOKS AIR FORCE BASE, TEXAS 78235-5501

WESTON

NOTICE

This report has been prepared for the United States Air Force by Roy F. Weston, Inc. for the purpose of aiding in the implementation of the Air Force Installation Restoration Program. It is not an endorsement of any product. The views expressed herein are those of the contractor and do not necessarily reflect the views of the publishing agency, the United States Air Force, nor the Department of Defense.

Copies of this report may be purchased from:

National Technical Information Service
5285 Port Royal Road
Springfield, Virginia 22161

Federal Government agencies and their contractors registered with Defense Technical Information Center should direct requests for copies of this report to:

Defense Technical Information Center
Cameron Station
Alexandria, Virginia 22314

REPORT DOCUMENTATION PAGE

1a REPORT SECURITY CLASSIFICATION Unclassified	1b RESTRICTIVE MARKINGS None
2a SECURITY CLASSIFICATION AUTHORITY NA	3 DISTRIBUTION / AVAILABILITY OF REPORT Approved for Public Release Distribution is Unlimited
2b DECLASSIFICATION / DOWNGRADING SCHEDULE NA	
4 PERFORMING ORGANIZATION REPORT NUMBER(S) NA	5 MONITORING ORGANIZATION REPORT NUMBER(S) NA
6a NAME OF PERFORMING ORGANIZATION ROY F. WESTON, INC.	6b OFFICE SYMBOL (If applicable)
6c ADDRESS (City, State, and ZIP Code) 100 Corporate North, Suite 101 Route 22 and Lakeside Drive Bannockburn, IL 60014	7a NAME OF MONITORING ORGANIZATION USAFOEHL/TSS 7b ADDRESS (City, State, and ZIP Code) Brooks AFB, TX 78235-5501
8a NAME OF FUNDING / SPONSORING ORGANIZATION USAFOEHL/TSS	8b OFFICE SYMBOL (If applicable)
8c ADDRESS (City, State, and ZIP Code) Brooks AFB, TX 78235-5501	9 PROCUREMENT INSTRUMENT IDENTIFICATION NUMBER F33615-80-D-4006 10 SOURCE OF FUNDING NUMBERS

PROGRAM ELEMENT NO.	PROJECT NO.	TASK NO	WORK UNIT ACCESSION NO

11 TITLE (Include Security Classification)
Final Report, IRP Phase II, Stage 1, Problem Confirmation Study
Selfridge ANGB, Mt. Clemens, MI

12 PERSONAL AUTHOR(S)
Jack E. Dowden, Harry M. Ricketts, Katherine A. Sheedy

13a TYPE OF REPORT	13b TIME COVERED	14 DATE OF REPORT (Year, Month, Day)	15 PAGE COUNT
Technical - Final	FROM 84-11 TO 86-10	1986 October 10	706

16 SUPPLEMENTARY NOTATION

17 COSATI CODES		
FIELD	GROUP	SUB-GROUP

18 SUBJECT TERMS (Continue on reverse if necessary and identify by block number)
Groundwater contamination, confirmation study, hazardous wastes, hazardous substances, groundwater monitoring, Selfridge ANGB, hazardous materials, IRP

19 ABSTRACT (Continue on reverse if necessary and identify by block number)

A problem confirmation study was performed at seven sites on Selfridge ANGB identified in the Phase I investigation as requiring further study (Southwest Sanitary Landfill, Fire Training Area 2, Fire Training Area 1, West Ramp Fuel Spill Site, Tucker Creek Landfill, Northwest Landfill, and East Ramp Fuel Spill Site). The field investigation was conducted from November 1984 to July 1985 and included installation of 25 monitor wells, collection and analysis of groundwater samples from the monitor wells, and collection and analysis of soil samples from the West and East Ramp Sites. Analytes included VOA, TOC, Phenols, COD, Cadmium, Chromium, Copper, Lead, Nickel, Zinc, Petroleum Hydrocarbons, Oil and Grease, EP Toxicity, and Ignitibility. Based on the hydrogeologic complexity of the physical setting and the findings of the sampling and analytical work, follow-on investigations have been recommended at all seven sites.

20 DISTRIBUTION / AVAILABILITY OF ABSTRACT	21 ABSTRACT SECURITY CLASSIFICATION
☒ UNCLASSIFIED/UNLIMITED ☐ SAME AS RPT ☐ DTIC USERS	Unclassified

22a NAME OF RESPONSIBLE INDIVIDUAL	22b TELEPHONE (Include Area Code)	22c OFFICE SYMBOL
Capt. Robart W. Bauer	512-536-2158/2159	USAFOEHL/TSS

WESTON

PREFACE

Roy F. Weston, Inc. (WESTON) has been retained by the U.S. Air Force Occupational and Environmental Health Laboratory (OEHL) under Contract F33615-80-D-4006, to provide general engineering, hydrogeological and analytical services. OEHL has authorized WESTON, under Task Order 0049 dated 17 September 1984, to conduct a Phase II Stage 1 Study for seven sites at Selfridge ANGB. The findings, conclusions, and recommendations of this study are contained herein.

The Phase II Stage I Confirmation Study at Selfridge ANGB was conducted under the auspices of staff personnel of Roy F. Weston, Inc. and was managed through WESTON's Bannockburn, Illinois office. The following personnel served lead functions in the performance of this project.

Mr. Peter J. Marks, Program Manager
Ms. Katherine A. Sheedy, P.G., Project Manager
Mr. Walter M. Leis, P.G., Geosciences QA Officer
Mr. Robert J. Karnauskas, P.G., P.HG., Project Coordinator
Mr. Jack Dowden, Senior Project Hydrogeologist
Dr. Earl Hansen, Laboratory Manager
Mr. Harry M. Ricketts, Assistant Project Geologist
Mr. David M. Stein, Assistant Project Geologist

WESTON expresses sincere thanks to the Base personnel at Selfridge ANGB for their assistance and cooperation throughout this project. WESTON would also like to acknowledge the efforts of Technical Engineers and Consultants and the surveying contractor, McMahon Engineering, during the field program.

This work was accomplished between November 1984 and July 1985. Captain Robart W. Bauer, Technical Services Division, USAF Occupational and Environmental Health Laboratory (USAF OEHL) was the technical monitor.

WESTON

TABLE OF CONTENTS

VOLUME I

TABLE OF CONTENTS
VOLUME I
(Continued)

TABLE OF CONTENTS
VOLUME I
(Continued)

TABLE OF CONTENTS
VOLUME I
(Continued)

TABLE OF CONTENTS
VOLUME I
(Continued)

TABLE OF CONTENTS

VOLUME 2

LIST OF FIGURES

LIST OF TABLES

LIST OF TABLES

APPENDICES

EXECUTIVE SUMMARY

ES 1.0 SCOPE OF WORK

This report describes the Phase II Stage 1 Problem Confirmation portion of the IRP effort conducted at Selfridge Air National Guard Base, Macomb County, Michigan.

The Selfridge Air National Guard Base occupies approximately 3184 acres adjacent to Lake St. Clair in Macomb County, Michigan. Since the initiation of military operations in 1917, activities at the Base, in support of mission operations, have resulted in the development of a number of areas suspected of potentially releasing hazardous substances to the environment.

The field investigation detailed in Task Order 0049 addressed the following seven sites.

- Site No. 1, Southwest Sanitary Landfill
- Site No. 2, Fire Training Area-2
- Site No. 3, Fire Training Area-1
- Site No. 4, West Ramp
- Site No. 5, Tucker Creek Landfill
- Site No. 6, Northwest Landfill
- Site No. 7, East Ramp

The locations of these sites is shown on Figure ES-1.

The scope of the investigation included the following activities:

- The installation of twenty-five monitoring wells at Selfridge ANGB
- Establishment of five surface water sampling sites
- The collection and analysis of one round of water quality samples from all groundwater monitoring wells and surface water monitoring sites
- The collection and analysis of soil samples
- The collection of three rounds of water-level measurements from each monitoring well on Figure ES-1

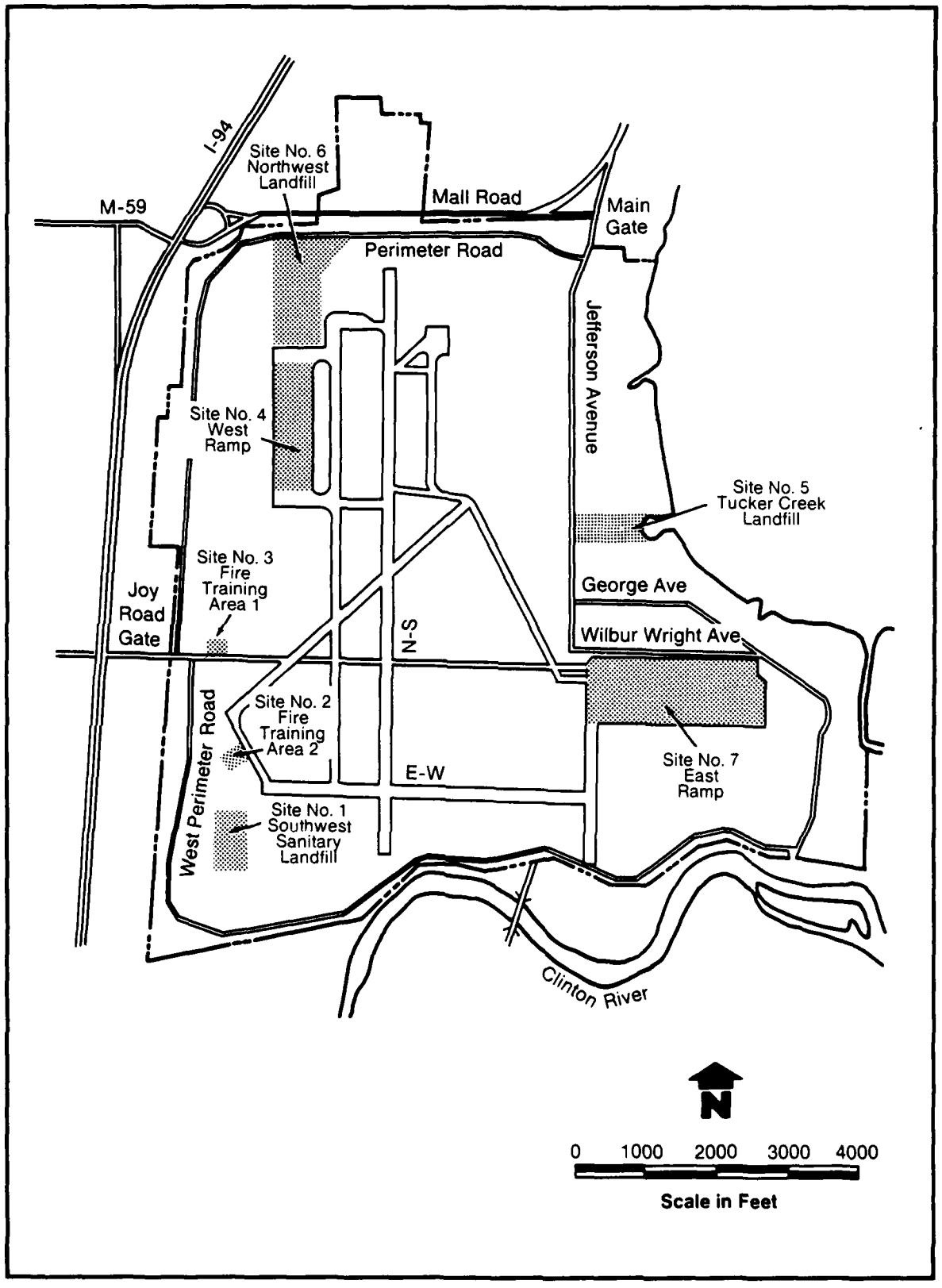


FIGURE ES-1 PHASE II STAGE 1 SITE LOCATIONS

ES 2.0 MAJOR FINDINGS

Based on examination of the air photo shown on Figure ES-2 and discussion with Base personnel it was determined that there was the potential for the Tucker Creek Landfill to be larger than originally thought. The extended area, shown on Figure ES-2, was reportedly used for disposal of fill and construction debris. In discussion Base personnel indicated that other wastes were deposited in this extended area and during the field investigation WESTON personnel observed drum rims protruding through the surface in this area.

The Selfridge ANGB is underlain by an eroded bedrock surface which has been filled with up to 200 feet of glacial, lacustrine and fluvial deposits. These deposits generally grade from fine grained silts and clays at the surface to poorly mixed silts, sand and gravels at depth. Near surface deposits of fine to medium grain sand occur discontinuously across the western, southern and northeastern portions of the Base.

Potable groundwater occurs within sand and gravel deposits of limited vertical and horizontal extent in the upper and middle sections of the unconsolidated deposits. The groundwater in these zones occurs under artesian pressures supplies water for domestic needs. The lower portion of the Devonian shale is known to yield highly mineralized waters that are not generally considered potable quality.

The regional hydraulic gradient of the groundwater in the unconsolidated aquifer(s) is eastward in conformance with the topographic gradient. Locally however, variations in the hydraulic gradient in the shallow water bearing zones may be influenced by incised creeks and ditches, backfilled excavations and natural permeability variations and may not conform to the regional gradient. In the immediate vicinity of Selfridge ANGB the groundwater in the shallow subsurface is believed to flow directly to Lake St. Clair or to tributary streams of the lake. Because most of the near surface deposits are fine-grained and of low permeability the groundwater flow and contaminant migration velocities are anticipated to be very low.

Elevated concentrations of total organic carbon were reported in all of the groundwater and surface water samples, with highest concentrations at the Southwest Sanitary Landfill, Fire Training Area-2 and the Northwest Landfill.

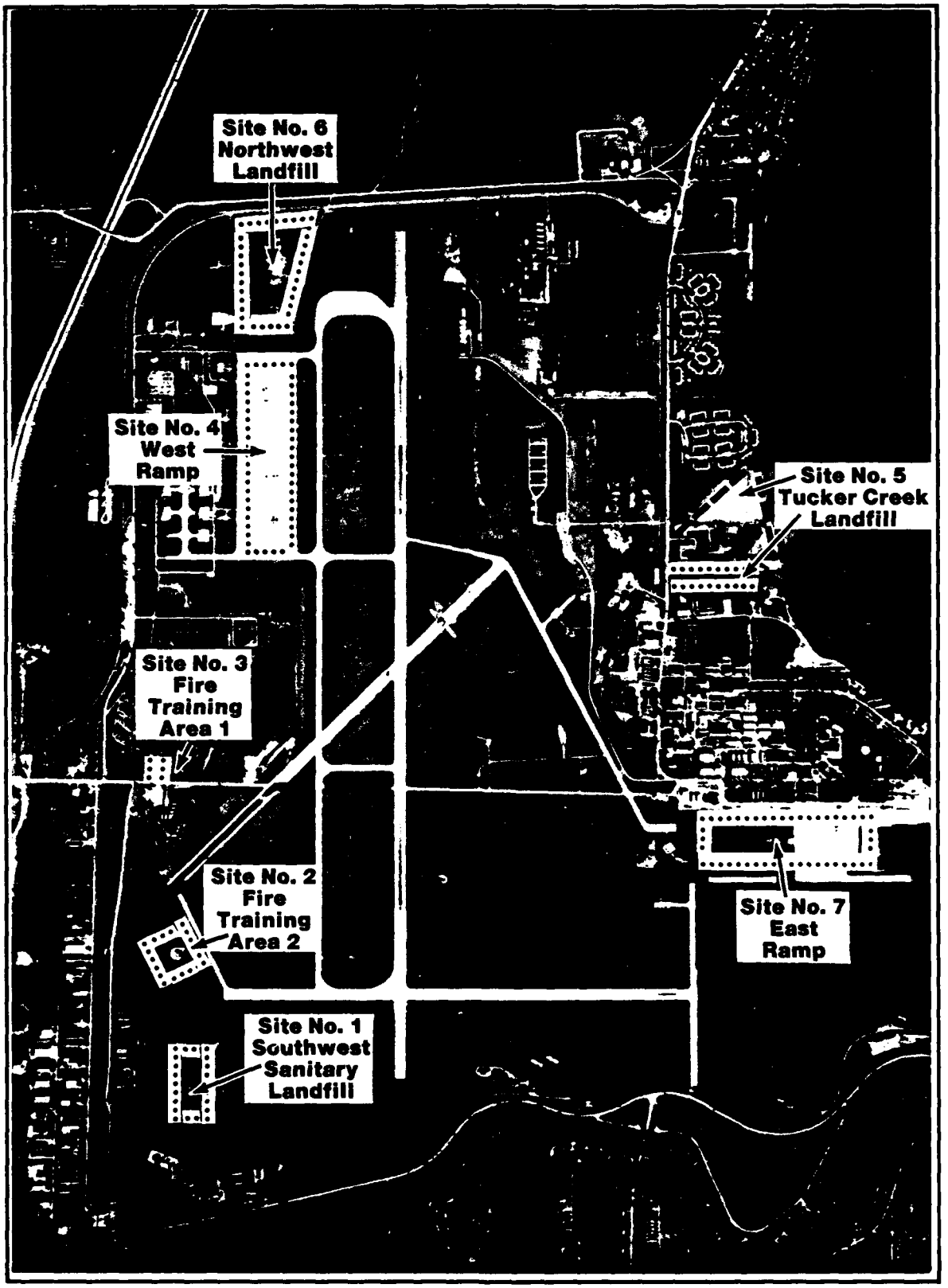


FIGURE ES-2 AERIAL PHOTOGRAPH OF SELFRIDGE AIR NATIONAL GUARD BASE SHOWING PHASE II INVESTIGATION SITES

Concentrations of phenols in excess of Federal water quality standards were detected in the groundwater at the Southwest Sanitary Landfill.

Elevated COD levels were reported in groundwaters adjacent to each landfill.

Oil and grease and petroleum hydrocarbon concentrations in excess of the taste and odor threshold were detected in all water samples.

Soluble copper concentrations in excess of the Federal Primary Drinking Water Standards were detected at each of the landfills. Soluble cadmium was also detected in excess of drinking water standards.

Detectable concentrations of volatile organic compounds (VOCs) were reported in 17 of 30 water samples and at six of the seven sites. Volatile organics were also detected in each of the 27 soil samples submitted for analyses. The VOC concentrations in two water samples from two sites (East Ramp and Southwest Landfill) are in excess of the recently proposed Federal Maximum Contaminant Level. Standards have not been established for volatile organic concentrations in soils. Volatile compounds detected tend to be those generally associated with fuels and solvents.

ES 3.0 CONCLUSIONS

Based on the results of the Phase II Stage 1 Study at the Selfridge Air National Guard Base, the following key conclusions have been drawn.

ES 3.1 HYDROGEOLOGY

1. A confined or semi-confined aquifer occurs within 15 feet of the land surface beneath the Selfridge ANGB. This aquifer occurs within Pleistocene-age unconsolidated sediments of glacial, lacustrine and fluvial origin.

2. The aquifer(s) within the unconsolidated sediments is the only significant source of potable groundwater in the Macomb County area. Typical yields from wells completed within these sediments are generally less than 10 gallons per minute. The production zones are generally relatively thin layers of sand and gravel occurring at depths greater than 25 feet.

3. At the time of monitoring well installation saturated materials were generally encountered at depths of 8 to 14 feet below land surface. The static water levels in all of the base monitoring wells stabilized within five feet of the land surface.

4. An analysis of the existing well records suggests that the artesian or confining pressure increases approximately 0.8 of a foot per foot of depth.

5. Groundwater in the upper portions of the unconsolidated sediments generally flows towards, and discharges to, either Lake St. Clair or the Clinton River. Local variations in the direction of groundwater flow may be induced by backfilled excavations and local topographic depressions.

6. The presence of low permeability clays of lacustrine origin at or near the land surface of the Base minimizes the potential for contamination of the underlying aquifers. However, because of the proximity of surface water bodies, the potential for migration of contaminants via surface runoff and/or groundwater flow is moderate to high.

ES 3.2 WATER QUALITY

1. The concentrations of soluble copper at each of the landfills and soluble cadmium at the Southwest Landfill are the only contaminants which were detected in excess of enforceable water quality standards.

2. The soils and groundwater beneath and adjacent to the East and West Ramps exhibit moderate to high levels of contamination. The analytical results suggest that the contaminants are those generally associated with fuel handling and storage activities.

3. The elevated concentrations of TOC, COD, phenols, petroleum hydrocarbon, soluble copper and cadmium, and VOC's in the western portion of the Southwest Landfill are indicative of a source of contamination in this area. The analyses of surface water samples from this site suggest that leachate from this landfill is affecting the quality of the adjacent surface waters. Total organic carbon

levels in the three ponds ranged from 6.8 to 11.5 mg/L, and Chemical Oxygen Demand levels ranged from 27 to 42 mg/L. Soluble copper levels ranged from 13 to 34 ug/L. It is presumed that these surface waters are eventually discharged to the Clinton River.

4. The elevated TOC, phenol and petroleum hydrocarbon concentrations in the water samples from Fire Training Area-2 indicate that the aquifer beneath this facility has been contaminated. The low permeability clays underlying this site have probably prevented severe subsurface contamination at this site.

5. Subsurface contamination exists beneath and adjacent to the Northwest and Tucker Creek Landfills and Fire Training Area-1. The existing water quality information at these sites is not sufficient to determine the nature, extent or severity of contamination.

6. The elevated COD levels in the monitoring wells around the Base landfills suggest that the anaerobic conditions requisite for methane generation are present at each of these sites. The existing site-specific information is not adequate to assess the potential for methane accumulation at these facilities.

7. It is suspected, on the basis of contamination in the upgradient well at Tucker Creek Landfill, that a fraction of the contaminants incorporated in the runoff from the ramps, runways and industrial operation areas may be concentrated in the soils and groundwater near the drainage system catch basins.

8. Based on the results of the Phase II Stage 1 Investigation the revised site priority ranking is as follows:

    1-Southwest Sanitary Landfill
    2-West Ramp
    3-East Ramp
    4-Fire Training Area-2
    5-Tucker Creek Landfill
    6-Northwest Landfill
    7-Fire Training Area-2

ES 4.0 RECOMMENDATIONS

ES 4.1 GENERAL

The findings of the Phase II Stage 1 Confirmation Study at Selfridge ANGB indicate that all the sites should be classified as Category II sites, requiring additional work to quantify or further assess the extent of existing or future contamination. A summary of the site-by-site discussion is presented on Table ES-1. The additional investigation activities should focus on:

1. Expansion of the monitoring and sampling program which will emphasize evaluation of the nature and extent of contamination by Priority Pollutant compounds and petroleum hydrocarbon compounds.

2. Evaluation of the potential contaminant pathways.

A summary of the specific recommendations for further investigative actions at each site is presented in Table ES-2.

TABLE ES-1

Summary of Site Classification
Selfridge Air National Guard Base

IRP Phase II Stage 1

Site Number and Reference	Stage II Investigation Category	Rationale	Supporting Subsection
1 - Southwest Landfill	II	Organic and soluble metal contamination in shallow aquifer with high potential to migrate to a Great Lakes tributary; further investigation required to define magnitude, extent and nature of contamination and evaluate migration pathways.	4.2 4.3.1 4.5.2 4.6
2 - Fire Training Area - 2	II	Hydrocarbon contamination in shallow aquifer of limited extent; further investigation required to define magnitude, extent and nature of contaminants.	4.2 4.3.2 4.5.2 4.6
3 - Fire Training Area - 1	II	Localized hydrocarbon contamination of shallow aquifer. No unacceptable health or environmental risks at current levels.	4.2 4.3.3 4.5.2 4.6
4 - West Ramp	II	Extensive organic contamination of a shallow aquifer and soil profile. Further investigation acquired to define magnitude, extent and nature of contamination.	4.2 4.3.4 4.4.1 4.5.2 4.6

TABLE ES-1 (Continued)

Site Number and Reference	Stage II Investigation Category	Rationale	Supporting Subsection
5 - Tucker Creek Landfill	II	Organic and soluble metal contamination in shallow aquifer adjacent to a Great Lake waterway; further investigation required to define extent, magnitude nature and source of contamination and assess potential for off-site migration.	4.2 4.3.5 4.5.2 4.6
6 - Northwest Landfill	II	Organic and soluble metal contamination in shallow aquifer; further investigation required to define magnitude, extent and nature of contamination and assess potential for impact from West Ramp sources.	4.2 4.3.6 4.5.2 4.6
7 - East Ramp	II	Extensive organic contamination of shallow aquifer and soil profile; further investigation required to define magnitude, extent and nature of contamination.	4.2 4.3.7 4.4.2 4.5.2 4.6

WESTON

TABLE ES-2

SUMMARY OF RECOMMENDATIONS

Recommendations	Purpose
Site No. 1, Southwest Sanitary Landfill	
1. Install four two-point monitor well nests.*	Assess magnitude and extent of contamination.
2. Sample storm runoff waters.	Assess impact of contamination on runoff water quality.
3. Analyze water samples for Priority Pollutants, petroleum hydrocarbon and leachate parameters.	Characterize site water quality.
4. Perform slug tests on monitoring wells.	Characterization of migration pathways.
5. Establish continuous water level monitoring station.	Characterization of hydrologic regime.
Site No. 2, Fire Training Area-2	
1. Install three borings within training area and sample and analyze soils from each boring.	Assess extent and magnitude of soil contamination.
2. Sample storm runoff waters.	Assess impact of contamination on runoff water quality.
3. Sample and analyze groundwater for petroleum hydrocarbons and Priority Pollutant organics.	Characterize groundwater quality.
4. Perform slug tests on monitoring wells.	Characterization of migration pathways.

* Each monitor well nest shall consist of an upper well which intersects the water table and a lower well point completed at a depth of 25 feet. Each monitor well point shall be completed in separate borings with 10 feet of well screen. The top of the screen in the upper monitor well point shall be two feet above the water table. However there must be a minimum two foot seal above the screen. Therefore the top of the screen shall be no closer than two feet to the ground surface.

TABLE ES-2 (Continued)

Recommendations	Purpose
Site No.3, Fire Training Area-1	
1. Install three borings within training area and sample and analyze soils from each boring.	Assess extent and magnitude of soil contamination.
2. Sample and analyze groundwater for petroleum hydrocarbon and Priority Pollutant organics and lead.	Characterize groundwater quality.
Site No. 4, West Ramp	
1. Install four sets of two-point monitor well nests.*	Assess extent and magnitude of contamination.
2. Install ten borings adjacent to catch basins, and sample and analyze soil samples from each boring.	Assess magnitude and extent of soil contamination.
3. Sample storm drainage waters.	Assess impact of contamination on drainage water quality.
4. Sample and analyze water for petroleum hydrocarbon, Priority Pollutant organics and lead.	Characterize site water quality.
5. Perform slug tests on monitoring wells.	Characterization of migration pathways.
6. Establish water level monitoring station.	Characterization of hydrologic regime.

* Each monitor well nest shall consist of an upper well which intersects the water table and a lower well point completed at a depth of 25 feet. Each monitor well point shall be completed in separate borings with 10 feet of well screen. The top of the screen in the upper monitor well point shall be two feet above the water table. However there must be a minimum two foot seal above the screen. Therefore the top of the screen shall be no closer than two feet to the ground surface.

TABLE ES-2 (Continued)

Recommendations	Purpose
7. Sample and analyze for total soil organic matter.	Assess attenuation capacity of soils.
Site No. 5, Tucker Creek Landfill	
1. Install three sets of two-point monitor well nests around eastern and northern perimeter.*	Assess magnitude and extent of groundwater contamination.
2. Install eight borings adjacent to storm drain catch basins and sample and analyze soils from each boring.	Assess magnitude and extent of soil contamination.
3. Sample storm runoff waters.	Assess impact of contamination on runoff water quality.
4. Sample and analyze waters for Priority Pollutants, landfill leachate parameters, TOC and COD.	Characterize site water quality.
5. Perform slug tests on monitoring wells.	Characterization of migration pathways.
Site No. 6, Northwest Landfill	
1. Install three sets of two-point monitoring well nests.*	Assess magnitude and extent of groundwater contamination.
2. Sample storm runoff waters.	Assess impact of contamination on runoff water quality.

* Each monitor well nest shall consist of an upper well which intersects the water table and a lower well point completed at a depth of 25 feet. Each monitor well point shall be completed in separate borings with 10 feet of well screen. The top of the screen in the upper monitor well point shall be two feet above the water table. However there must be a minimum two foot seal above the screen. Therefore the top of the screen shall be no closer than two feet to the ground surface.

TABLE ES-2 (Continued)

Recommendations	Purpose
3. Sample and analyze water for Priority Pollutants, landfill leachate parameters, TOC and COD.	Characterize site runoff waters.
4. Perform slug tests on monitoring wells.	Characterization of migration pathways.
Site No. 7, East Ramp	
1. Install four sets of two-point monitor well nests.*	Assess extent and magnitude of groundwater contamination.
2. Install two borings adjacent to storm drain and sample and analyze soils from each boring.	Assess extent and magnitude of soil contamination.
3. Sample storm runoff waters.	Assess impact of contamination on runoff water quality.
4. Sample and analyze waters for petroleum hydrocarbon, Priority Pollutant organics and lead.	Characterize site water quality.
5. Perform slug tests on monitoring wells.	Characterization of migration pathways.
6. Establish water level monitoring station.	Characterization of hydrologic regime.
7. Sample and analyze for total soil organic matter.	Assess attenuation capacity of soils.

* Each monitor well nest shall consist of an upper well which intersects the water table and a lower well point completed at a depth of 25 feet. Each monitor well point shall be completed in separate borings with 10 feet of well screen. The top of the screen in the upper monitor well point shall be two feet above the water table. However there must be a minimum two foot seal above the screen. Therefore the top of the screen shall be no closer than two feet to the ground surface.

SECTION 1

INTRODUCTION

1.1 INSTALLATION RESTORATION PROGRAM

The purpose of the Installation Restoration Program (IRP) is to assess and control the potential migration of environmental contamination that may have resulted from past operations and disposal practices on DoD facilities. In response to the Resource Conservation and Recovery Act of 1976 (RCRA), and in anticipation of the Comprehensive Environmental Response Compensation and Liability Act of 1980 (CERCLA, or "Superfund"), the DoD issued a Defense Environmental Quality Program Policy Memorandum of past hazardous waste disposal sites on DoD installations. The U.S. Air Force implemented DEQPPM 80-6 in December 1980. The program was revised by DEQPPM 81-5 (11 December 1981), which reissued and amplified all previous directives and memoranda on the IRP. The Air Force implemented DEQPPM 81-5 on 21 January 1982. The Installation Restoration Program has been developed as a four-phase program, as follows:

- Phase I - Problem Identification/Records Search
- Phase II - Problem Confirmation and Quantification
- Phase III- Technology Base Development
- Phase IV - Corrective Action

The Phase II, Stage 1, Problem Confirmation Study portion of the IRP effort at Mather Air Force Base was included in the effort described in this report. Definitions of the terms, nomenclature, acronymns, and units of measurement used in this report are contained in Appendix A.

1.2 PROGRAM HISTORY AT SELFRIDGE AIR FORCE BASE

Roy F. Weston, Inc. (WESTON) has been retained by the U.S. Air Force Occupational and Environmental Health Laboratory (OEHL) under Contract F33615-80-D-4006, to provide general engineering, hydrogeological and analytical services. The Phase I, Problem Identification/Records Search for Selfridge

ANGB was performed by Environmental Control Technology Corp. in April, 1983. In response to the findings contained in the Environmental Control Technology Corp. Phase I final report, the OEHL issued Task Order 0037 to WESTON, directing that a presurvey be conducted at Selfridge ANGB. The purpose of this presurvey was to obtain sufficient information to develop a work scope and cost estimate for the performance of a Phase II Stage 1 Problem Confirmation Study.

The presurvey report for Selfridge ANGB was submitted by WESTON in May 1984. Following a review of the report and modifications of the scope of work, Task Order 0049, dated 17 September 1984, was issued authorizing a Phase II Stage 1 Study for seven sites at Selfridge ANGB. A copy of the Task Order authorizing this effort is presented in Appendix B.

1.3 BASE PROFILE

Selfridge ANGB is situated on the western shore of Lake St. Clair, 0.5 miles to the east of Mount Clemens, Michigan, as shown on the location map Figure 1-1. The Base has been active since 1922 operating under the Army, Air Force, and Air National Guard Command. The primary mission of the Base is to train Air National Guard personnel.

Selfridge Field began with the leasing of 640 acres of farmland by the U.S. Army in 1917. By 1922, the initial Base land area was purchased, establishing the facility as a permanent installation. Considerable expansion of the Base occurred during World War II, with the Base reaching its present size of 3,184 acres. Selfridge Field remained under the administration of the U.S. Army until 1947, when the Air Force was established as a separate service and the Base became an Air Force installation. In 1971, control of the facility was transferred to the Michigan Air National Guard, who currently maintain authority over its operation.

The present and past Air National Guard and Air Force activities at Selfridge ANGB, in support of training and operational missions, have resulted in the occurrence of several hazardous waste utilization and disposal sites of potential concern which are suspected to contain hazardous materials. Table 1-1 contains a list of all sites of potential concern that received priority rankings during the Phase I investigation. The priority rankings were determined by Environmental Control Technology Corp. using the

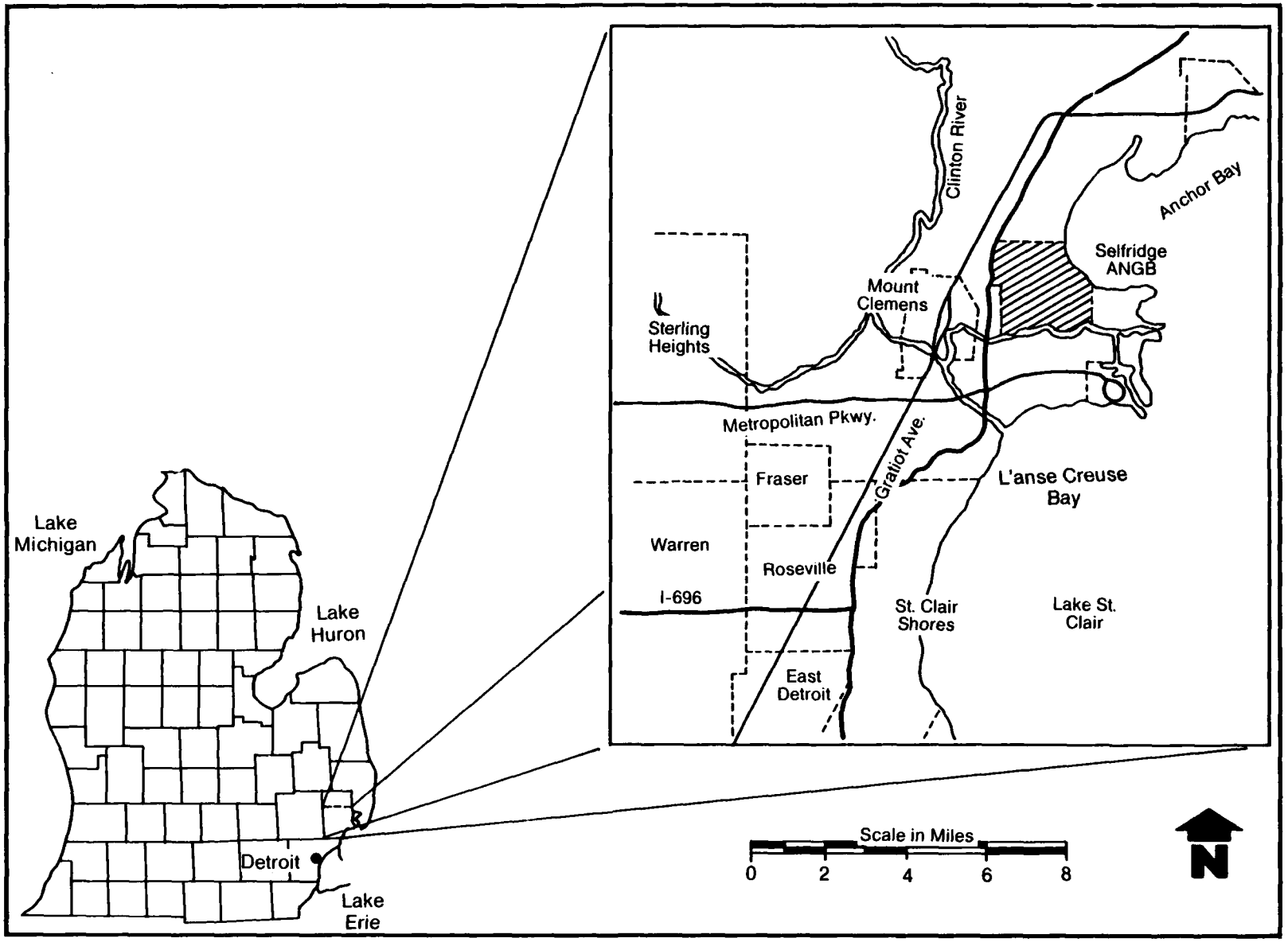


FIGURE 1-1 LOCATION OF SELFRIDGE AIR NATIONAL GUARD BASE

TABLE 1-1

PRIORITY RANKING OF DISPOSAL SITES
FROM THE PHASE I REPORT
SELFRIDGE ANG BASE

PRIORITY RANKING	SITE NAME	TOTAL OVERALL HARM SCORE
1	Southwest Landfill	74.7
2	Fire Training Area - 2	71.8
3	Fire Training Area - 1	70.5
4	West Ramp Fuel Spill	66.4
5	Northwest Landfill	64.9
6	East Ramp Fuel Spill	60.7
7	Tucker Creek Landfill	59.4

Hazard Assessment Rating Method (HARM). Based on consultation with OEHL personnel during the presurvey, and confirmed by WESTON's letter of 26 April 1984 to Mr. Emil Baladi, IRP Program Manager, the following modifications were made with regard to the number of sites to be evaluated in Phase II and their ranking:

- The January 1984 Fuel Spill Site (POL Storage Site, No. 8) was incorporated into a zone within the West Ramp Fuel Spill Site (No. 4). Figure 1-1
- Priority for the Tucker Creek Landfill Site was changed from 7 to 5. Thus, the Northwest Landfill Site dropped to Priority Ranking No. 6, the East Ramp Fuel Spill Site dropped to Priority No. 7.

The POL storage site was mistakenly identified as Priority Ranking 8 in WESTON's 26 April 1984 letter when it was intended to be included within the West Ramp Fuel Spill site, as indicated above.

The modification in priority for the Tucker Creek Landfill was based on the presurvey observations of the proximity of potential hazardous materials in this landfill to the Base school and playground (within several hundred feet). The final list of sites requiring Phase II evaluation and the final priority rankings are shown in Table 1-2. The disposal site locations are shown on Figure 1-2. Figure 1-3 shows the disposal site locations plotted on an undated aerial photograph of the site. Sites 1, 4, and 7 are obscured on the photograph.

1.3.1 History and Description of Site No. 1, Southwest Sanitary Landfill

The Southwest Landfill is located in the southwest corner of the Base. This facility is located in an undeveloped area of the Base bounded by the Perimeter Road on the west and south and the airfield to the northeast. The 40 acre site operated from 1970 to 1978 under Michigan Public Act 87, as amended, for the disposal of approximately 5,900 tons per year of residential and industrial waste. Clayey sand was used for daily cover. Typical wastes disposed of at this site included residential wastes, demolition materials, solvents such as trichloroethylene, carbon tetrachloride, and methyl ethyl ketone, paint strippers and thinners, and waste oils. A large number of drummed waste paints and solvents are also thought to be buried at this location.

TABLE 1-2

FINAL LIST OF SITES FOR
PHASE II EVALUATION AND
PRIORITY RANKING

PRIORITY RANKING	SITE NAME	TOTAL OVERALL HARM SCORE
1	Southwest Landfill	74.7
2	Fire Training Area - 2	71.8
3	Fire Training Area - 1	70.5
4	West Ramp Fuel Spill and Jan. 1984 Spill Site	66.4
5	Tucker Creek Landfill	59.4
6	Northwest Landfill	64.9
7	East Ramp Fuel Spill	60.7

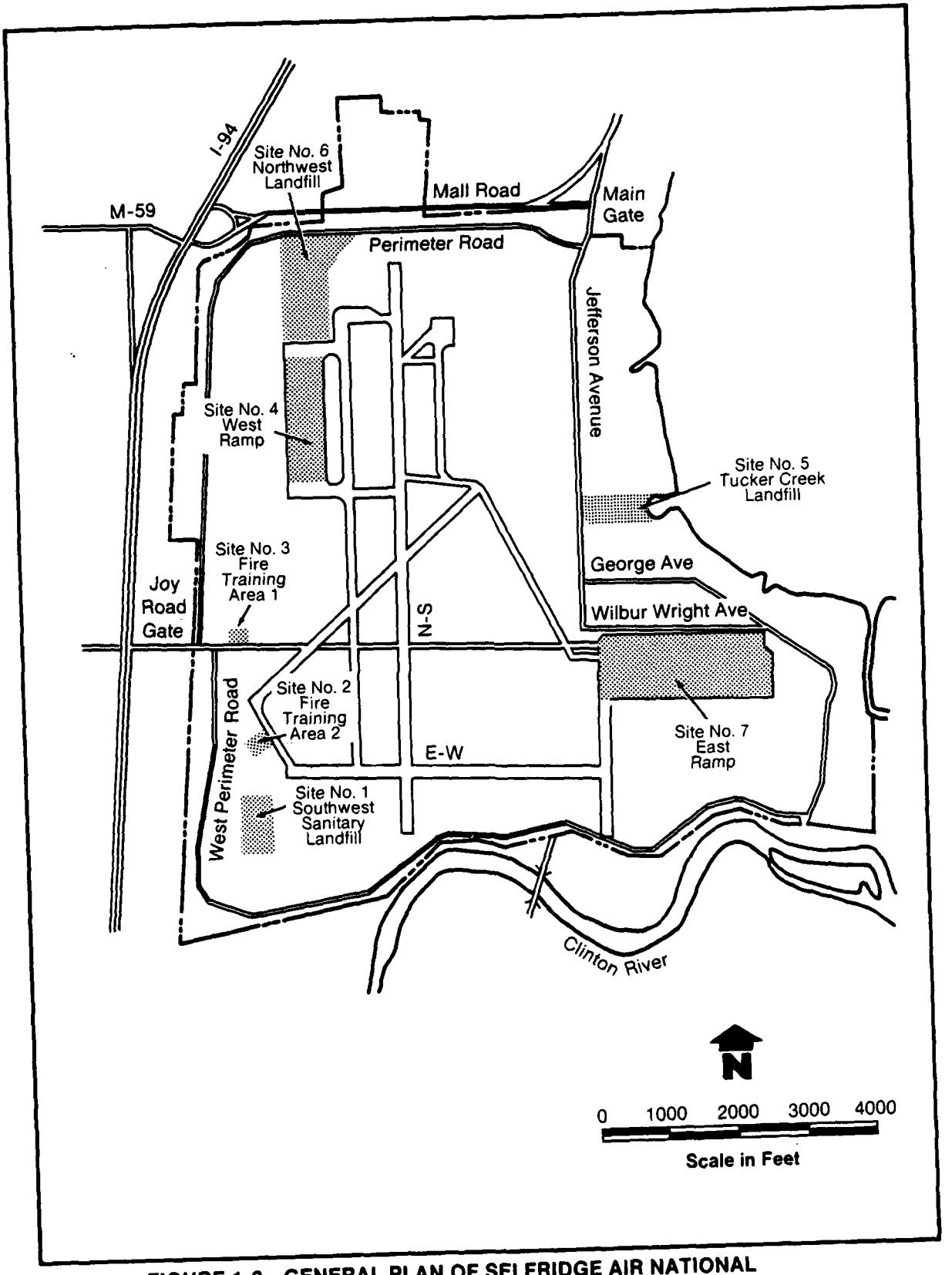


FIGURE 1-2 GENERAL PLAN OF SELFRIDGE AIR NATIONAL GUARD BASE SHOWING PHASE II INVESTIGATION SITES

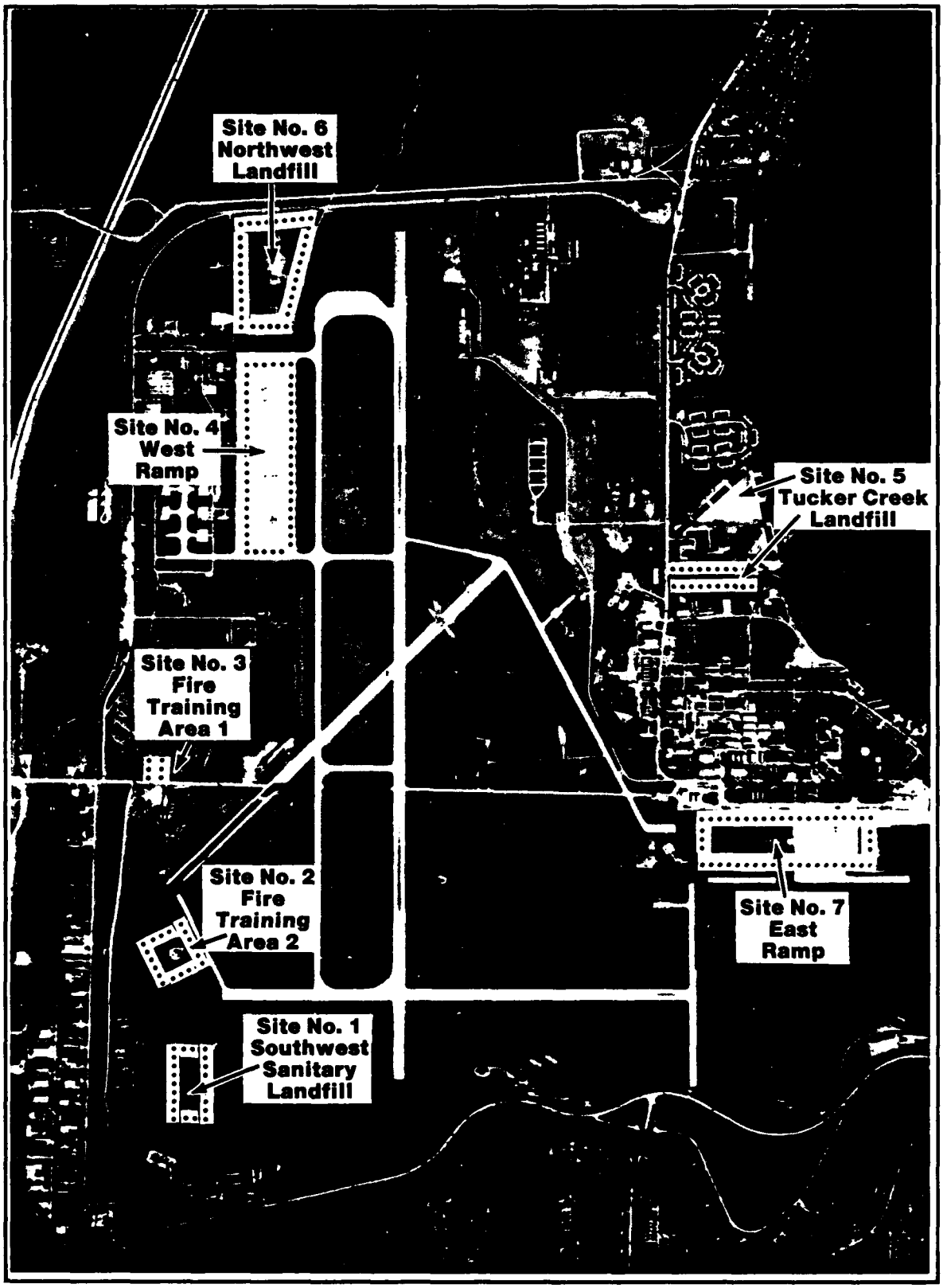


FIGURE 1-3 AERIAL PHOTOGRAPH OF SELFRIDGE AIR NATIONAL GUARD BASE SHOWING PHASE II INVESTIGATION SITES

There is no evidence that a compacted clay on synthetic liner was installed at the site. Currently the site is used for the disposal of demolition and landscape debris and ash from the Base coal-fired power plant. A general plan of this site is presented in Figure 1-4.

1.3.2 History and Description of Site No. 2, Fire Training Area 2

The Fire Training Area 2 is located in the southwest quadrant of the Base, north of the Southwest Landfill and west of the C Taxiway. Selfridge ANGB fire department personnel have used this pit since 1968 to conduct fire training exercises. The pit, which is approximately 100 feet in diameter, was excavated 1 to 1.5 feet below land surface (BLS) and filled with broken concrete and demolition materials. No liner was installed prior to backfilling the pit excavaton. As shown on Figure 1-5, a raised berm surrounds the pit. Historically, an average of 8 to 12 training fires have been and continue to be conducted each year. During a training exercise, 350 to 500 gallons of JP-4 containing up to 10% sediment contaminants is fed into the pit via a fuel line connected to a 2,500 gallon storage tank. The fuel is then ignited and extinguished using water and aqueous film forming foam (AFFF). Fire department personnel estimate that approximately 75% of the fuel is consumed per event (25% residue). The fire training pit is periodically drained to an impoundment southwest of the site through an open ditch (Table 1-2).

1.3.3 History and Description of Site No.3, Fire Training Area 1

Fire Training Area 1 was located to the north of Fire Training Area 2, near Building 567 in an unlined pit which was backfilled with gravel. The fire department trained exclusively with flammable waste materials from 1952 until 1967. Waste flammables (i.e., JP-4, solvents, strippers, and thinners) were stored in drums, on-site, between fire training exercises. It is assumed that the combustion efficiency at this site is similiar to that of the existing training facility (7TA-2). Although no drawings of this facility exist, it is believed to have been similar in constructon and configuration to Fire Training Area 2. This quarter-acre site is currently surrounded by a security fence and is bounded on the west, north and east by wooded areas and on the south by Joy Boulevard. The site is currently utilized as a parking (unpaved) area. A general plan of this site is presented in Figure 1-6.

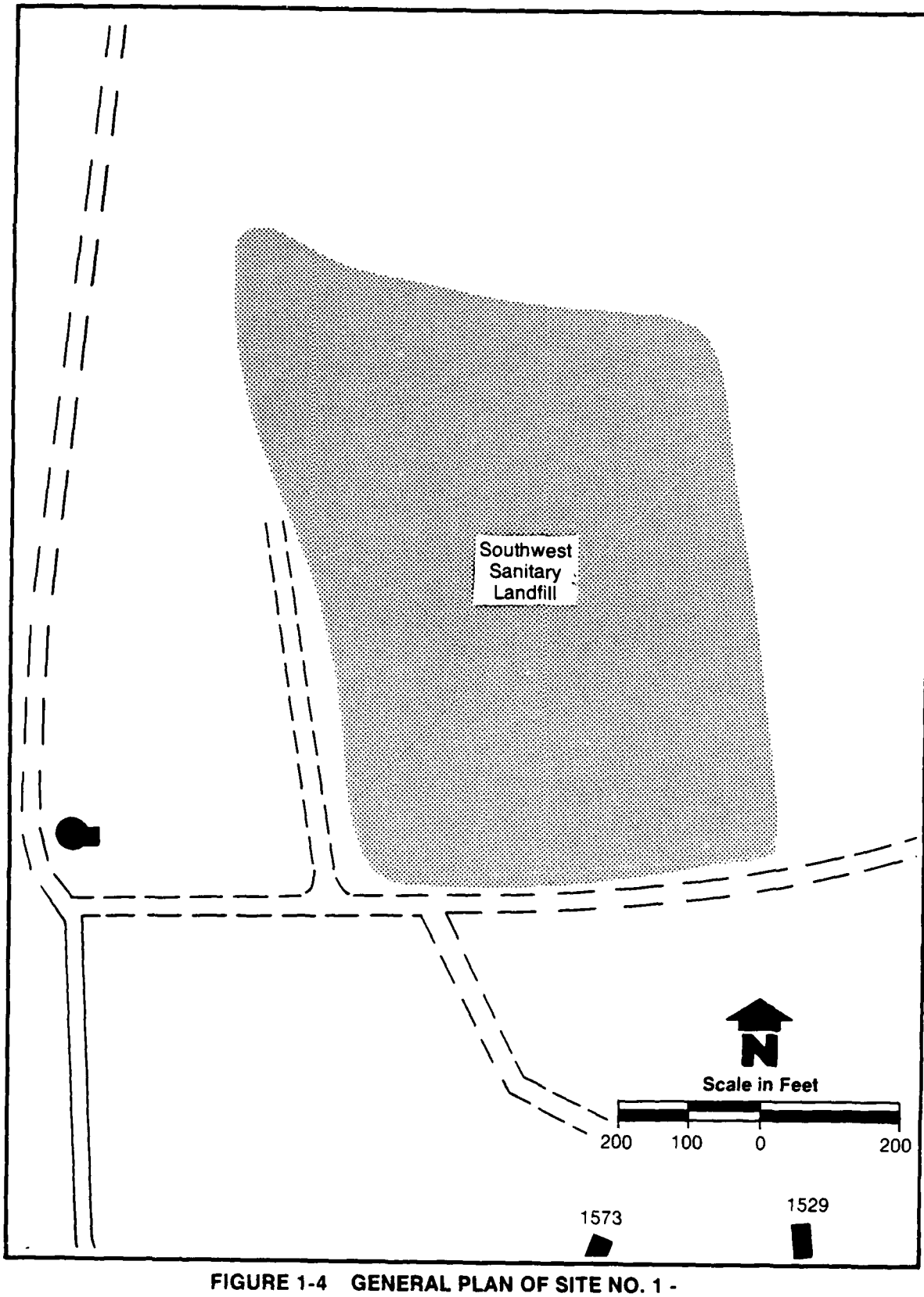


FIGURE 1-4 GENERAL PLAN OF SITE NO. 1 - SOUTHWEST SANITARY LANDFILL

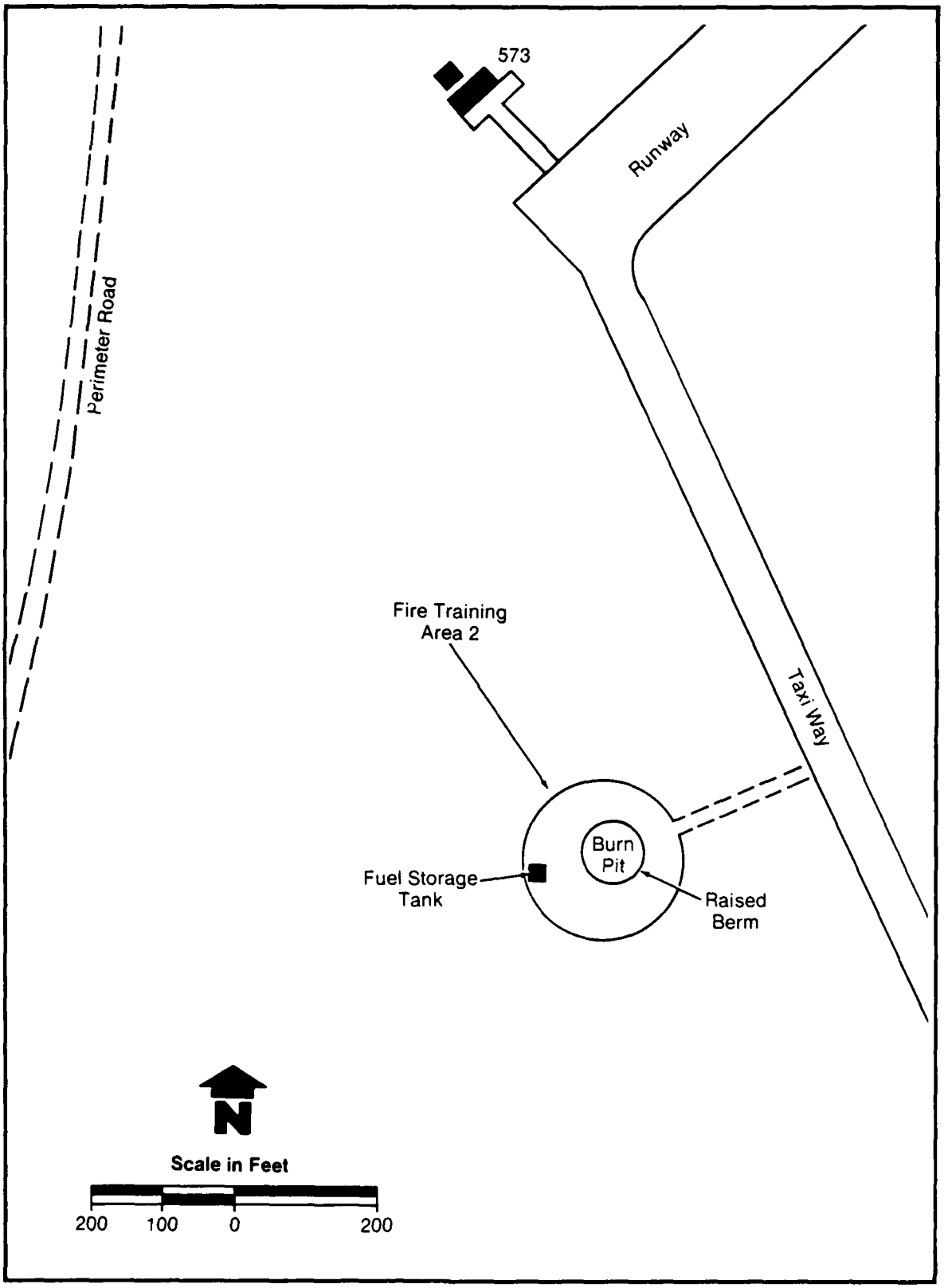


FIGURE 1-5 GENERAL PLAN OF SITE NO. 2 - FIRE TRAINING AREA 2

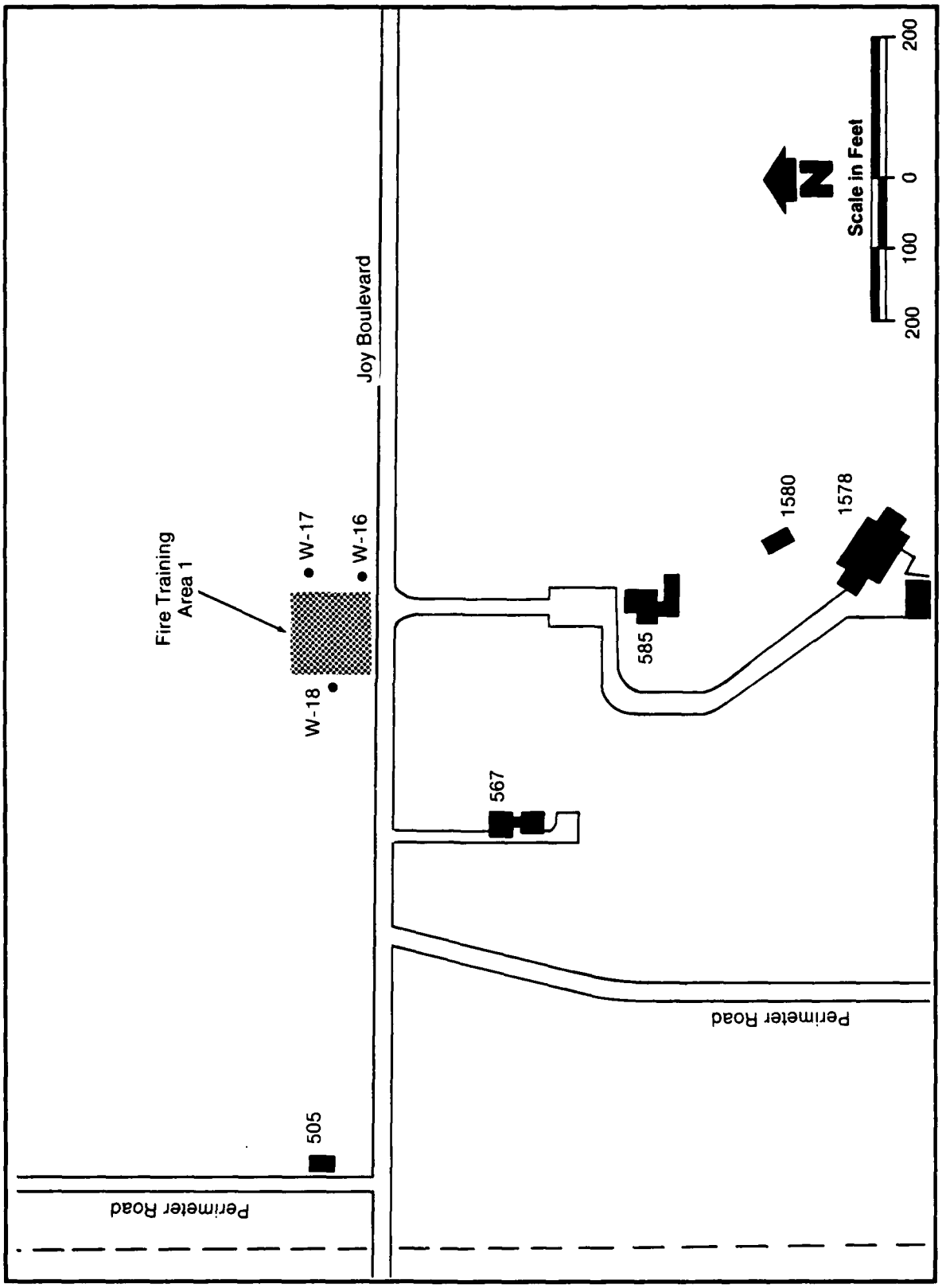


FIGURE 1-6 GENERAL PLAN OF SITE NO. 3 - FIRE TRAINING AREA 1

1.3.4 History and Description of Site No. 4, West Ramp

The ramps at Selfridge ANG Base are utilized for aircraft parking, maintenance and fueling. The West Ramp occupies approximately 85 acres in the northwest portion of the Base. The West Ramp is bounded on the north by the Northwest landfill (site No. 6), on the east by the airfield, on the south by an undeveloped wooded area and on the west by aircraft hangers and support buildings. The fuel spill area of concern on the west ramp is located in the southwest of the aircraft parking area, near a buried fuel line pump station. Two fuel spills have occurred near this pump station involving over 3,000 gallons of JP-4 fuel. Both of these spills were related to malfunctions of the pumping equipment. Remedial clean-up activities were attempted by Base personnel, however, the bulk of the fuel drained off the ramp to a landscaped depression between the aircraft hangers and the parking area. Base personnel have reported a strong fuel odor in this area during extensive wet periods. A site plan is shown on Figure 1-7.

1.3.5 History and Description of Site No. 5, Tucker Creek Landfill

From 1930 to 1955, a natural depression on the east side of the Base, commonly called Tucker Creek, was used for disposal of waste materials. Refuse was burned and buried here. Demolition materials, residential refuse, and industrial waste materials such as carbon tetrachloride and trichloroethylene were disposed of in this area. The site is bounded on the north by Building 970, the south by the Base school, the east by the lake, and the west by Jefferson Avenue. Aerial photograph (Figure 1-3) shows that there is a larger disturbed zone in this area. The disturbance indicates that filling occurred to the north and northeast of the boundaries described. During the field operations conducted for this study construction debris and drum rims could be seen at the surface in the larger area. In addition, in discussion with Base personnel WESTON field personnel were told that industrial type wastes were deposited in this area. A site plan showing both the originally designated boundary and the disturbed area is shown on Figure 1-8.

1.3.6 History and Description of Site No. 6, Northwest Landfill

The Northwest Landfill is located in the northwest corner of the Base. From 1955 to 1975 this site was used for the landfilling of waste products. Originally, this 26 acre

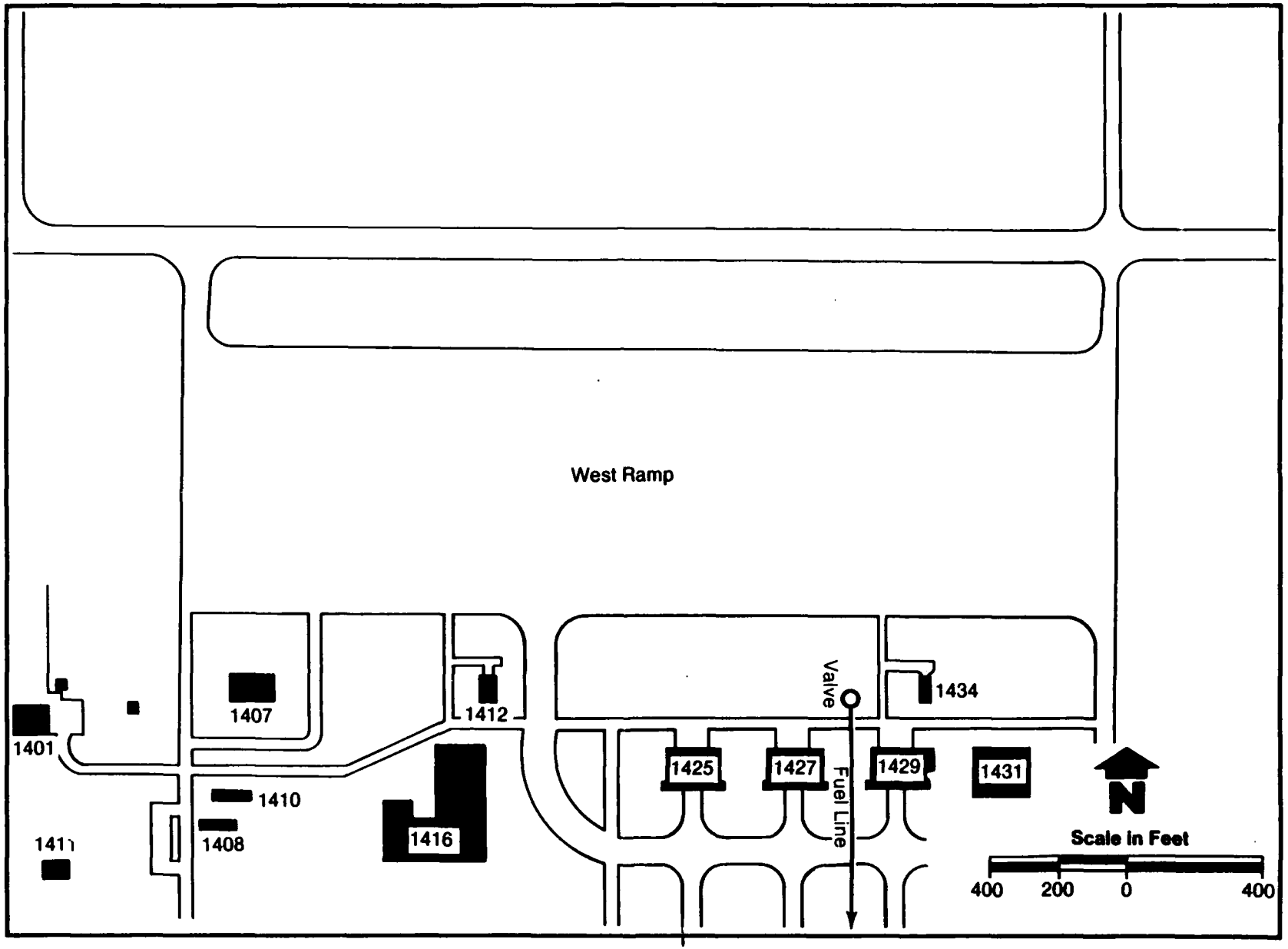


FIGURE 1-7 GENERAL PLAN OF SITE NO. 4 - WEST RAMP

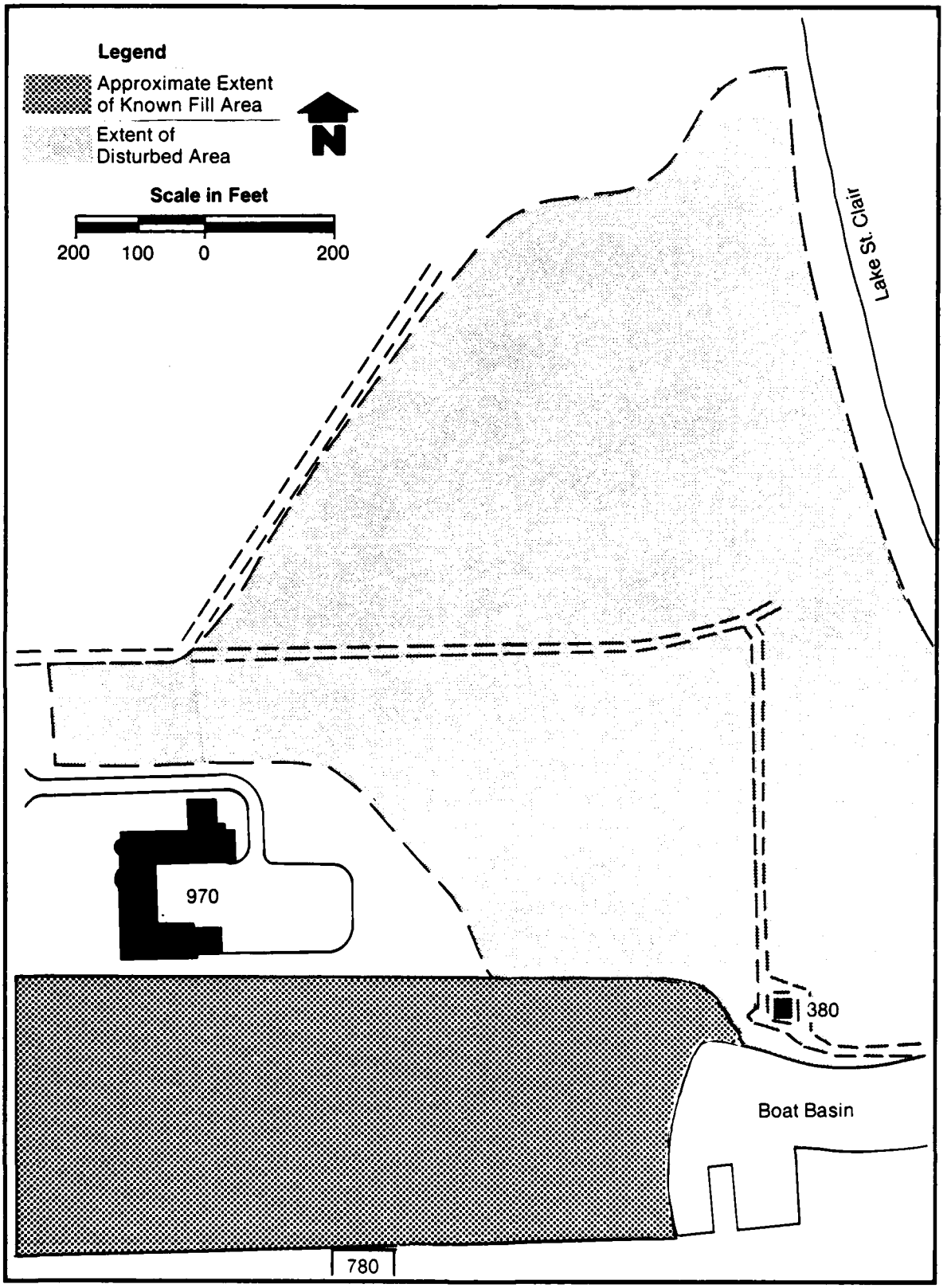


FIGURE 1-8 GENERAL PLAN OF SITE NO. 5 - TUCKER CREEK LANDFILL

site was a natural sand pit from which the sand was excavated completely, down to blue clay, for the construction of the runways. Demolition materials were placed on the bottom of the pit followed by landfilling of residential and industrial waste. Clay and clayey sands were used for daily cover. This site contains industrial waste products such as solvents, paint thinners, paint strippers, waste oils and fuels. Fuel Management reports disposing of 50 to 150 gallons of tetraethyl lead at this site during its operation. The site is bounded by the Perimeter Road to the north, the airfield to the east, the West Ramp to the south and a radar station to the west. The approximate configuration of the site is shown on Figure 1-9.

1.3.7 History and Description of Site No. 7, East Ramp

The East Ramp occupies approximately 75 acres in the southeastern portion of the Base. The East Ramp is bounded on the north and east by the contaminant area, to the south by the golf course and to the west by the airfield. According to the Phase I report approximately 6,000 gallons of JP-4 were spilled at an unspecified location on the East Ramp. Remedial cleanup activities were attempted, however, the bulk of the spill drained off of the East Ramp. Base personnel report a strong petroleum spirits aroma that appears during extensive wet periods in the vicinity of the East Ramp. Figure 1-10 is a general plan of this site area.

1.4 CONTAMINATION PROFILE

At Selfridge ANGB most of the products containing hazardous and potentially hazardous wastes are generated by the routine maintenance of aircraft and ground vehicles, with lesser amounts generated by grounds maintenance activities. The primary products of concern are petroleum products, halogenated organic solvents, chlorinated solvents, paint thinner and remover, waste oils and pesticides. Other contaminants of lesser hazard have also been generated in support of Base activities.

Information regarding the generation and disposal of hazardous wastes and contaminants was obtained by means of a records search and interviews with Base military personnel, civilian employees, and retired personnel, and was presented in the Phase I Report (Environmental Control Technology Corp., 1983). Disposal of hazardous wastes on Base have been handled in a number of different ways. Waste oils were sprayed on dirt roads for dust control. Large amounts of flammable wastes were burned in the unlined Fire Training

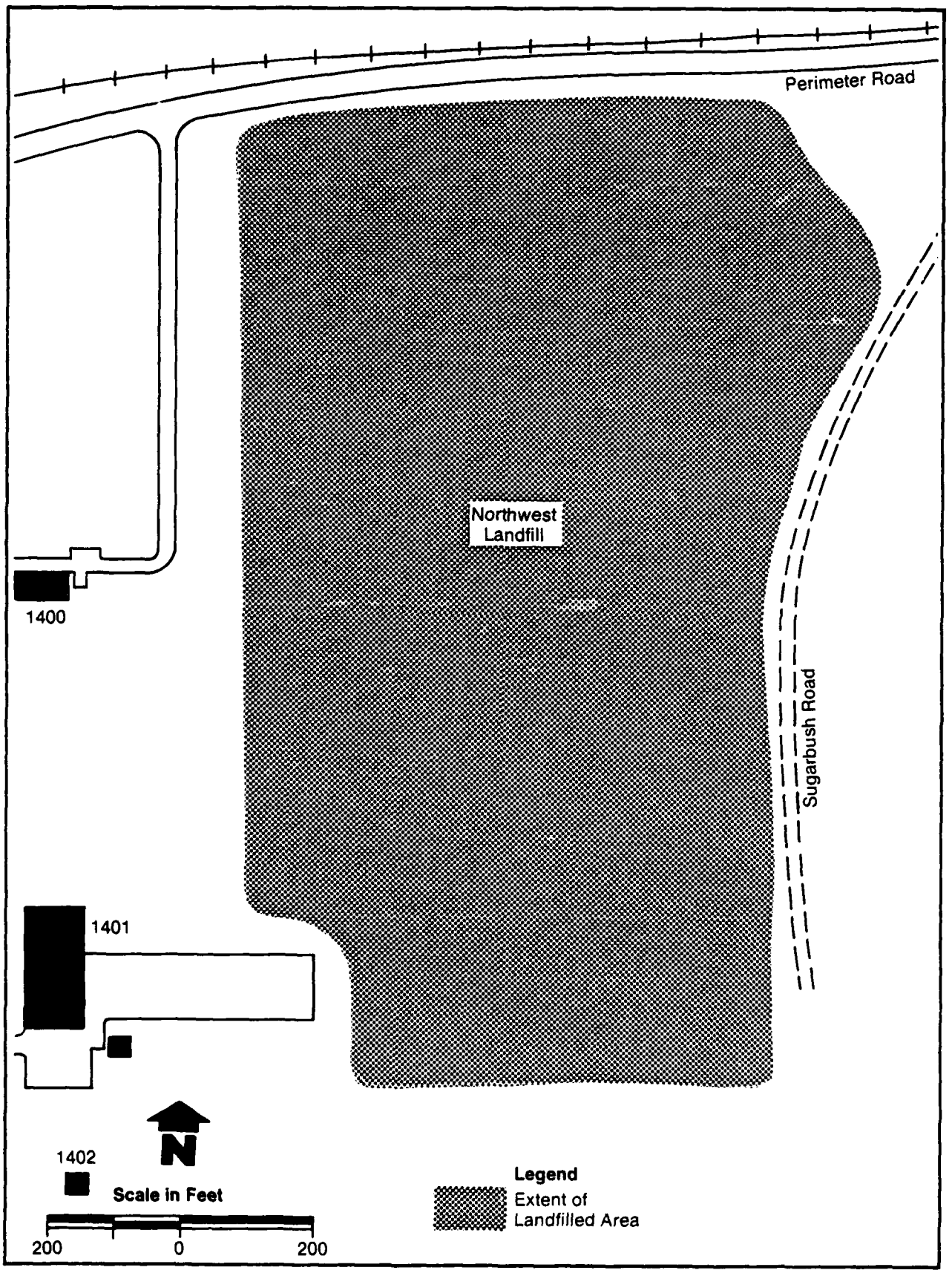


FIGURE 1-9 GENERAL PLAN OF SITE NO. 6 - NORTHWEST LANDFILL

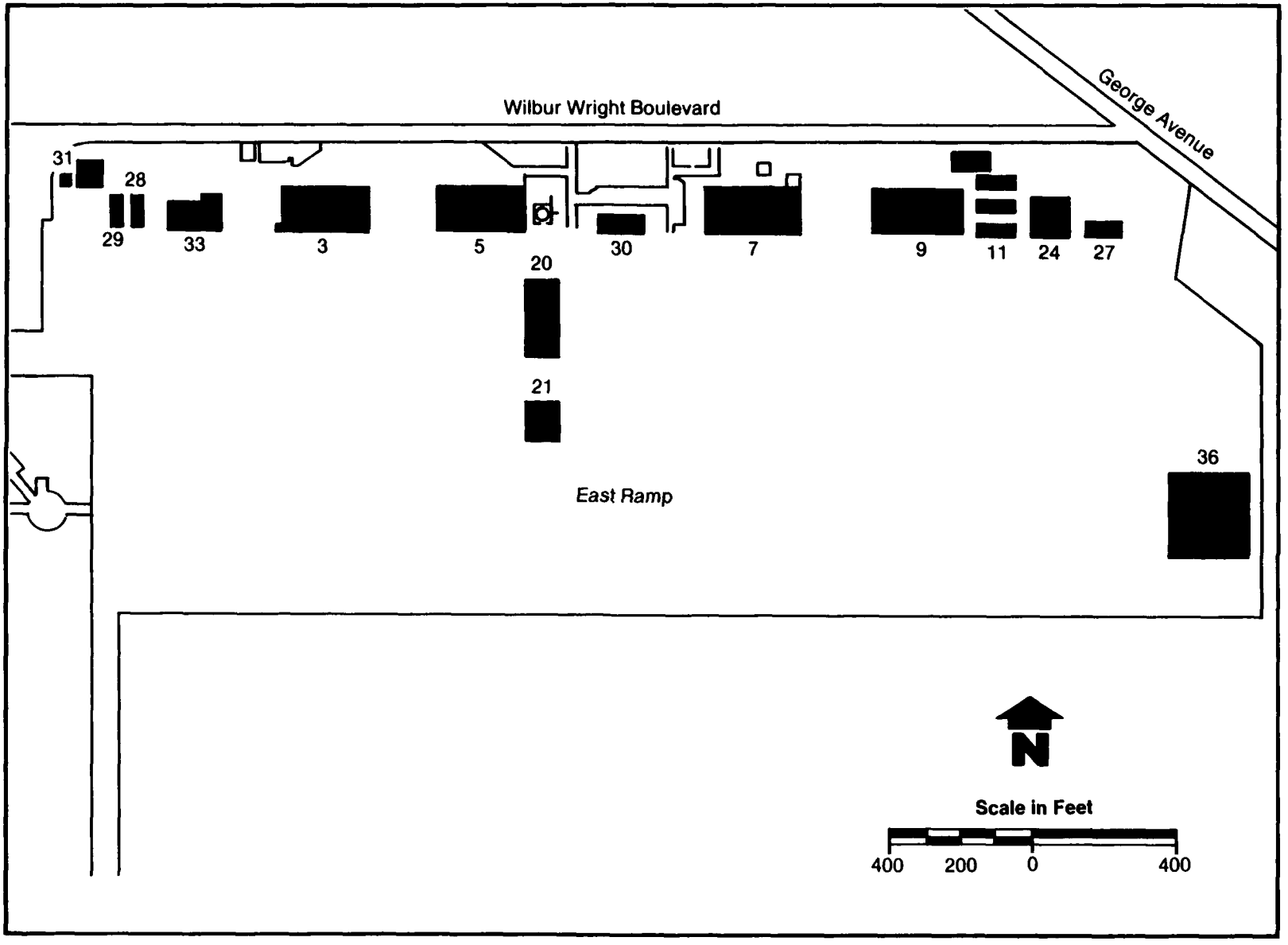


FIGURE 1-10 GENERAL PLAN OF SITE NO. 7 - EAST RAMP

Area 1 pit up to 1968. Since that time JP-4 and AVGAS have been used by the fire department for training exercises. Large quantities of residual and unconsumed flammable liquids exist at each of the Fire Training Areas. The potential for environmental contamination from the Fire Training Areas is high due to a moderately high potential for migration of contaminants beyond Base via surface water runoff. Reportedly, one common method of waste disposal was pouring wastes directly into storm and sanitary system drains. Substantial quantities of industrial solvents, paint wastes, and petroleum products have been disposed of in the Landfills on Base. Potential is considered moderate to high for the migration of contaminants beyond Base boundaries from the landfills. A significant factor in consideration of contaminant migration is the longevity of the landfill operations; 22 years for the Northwest Landfill and 25 years for the Tucker Creek Landfill. Approximately 6,000 gallons of jet fuel has entered the soils around the East and West Ramps due to spills and may also contribute to the introduction of contaminants to surface waters and groundwaters.

Based on the Selfridge ANGB Phase I records search and the Phase II presurvey report, the key contaminant indicator parameters applicable to the Base contamination profile are volatile organic compounds (VOA), chemical oxygen demand (COD), total organic carbon (TOC), phenolics, oil and grease, and metals (cadmium, chromium, copper, lead, nickel, and zinc). The potential contaminants and associated analytes for each site are presented in Table 1-3.

1.5 FACTORS OF CONCERN

The primary factor of concern at Selfridge ANGB is the potential for contamination of surface or near surface water resources. This potential is considered moderate to high for the following reasons:

- Lateral migration of contaminants toward surface and subsurface drainage particularly in the surficial sands at the south edge of the Base which may extend for several thousand feet off Base.
- Age and length of service of the contamination sources and quantity of waste contained therein.
- Persistence and mobility of potential contaminants

TABLE 1-3

SUMMARY OF ANALYTICAL PROTOCOL AT SELFRIDGE ANGB

Site	Potential Contaminants	Medium	Analytes
Southwest Landfill	Solvents, paint wastes, petroleum	Water	VOA, TOC phenols, COD, Metals[1], oil and grease
Fire Training Area-2	Petroleum products	Water	VOA, TOC, phenols, petroleum hydrocarbon
Fire Training Area-1	Solvents, paint wastes, petroleum products	Water	VOA, TOC, phenols, petroleum hydrocarbon
West Ramp Fuel Spill and Jan. 1984 Spill Site	JP-4	Water Soil	VOA, TOC, petroleum hydrocarbon, petroleum hydrocarbon, VOA
Tucker Creek Landfill	Solvents, paint wastes, petroleum products	Water	VOA, TOC, phenols, COD, metals[1], oil and grease
Northwest Landfill	Solvents, paint wastes, petroleum products	Water	VOA, TOC, phenols, COD, metals[1], oil and grease
East Ramp Fuel Spill	JP-4	Water Soil	VOA, TOC, petroleum hydrocarbon, petroleum hydrocarbon, VOA

[1] Metals include: Cadmium, Chromium, Copper, Lead, Nickel, and Zinc

- o Proximity of contamination sources to Base boundaries.

1.6 PROJECT TEAM

The Phase II Stage 1 Confirmation Study at Selfridge ANGB was conducted by and under the auspices of staff personnel of Roy F. Weston, Inc., and was managed through WESTON's Bannockburn, Illinois office. The following personnel served lead functions in the performance of this project:

Mr. Peter J. Marks, Program Manager: Corporate Vice President, Master of Science (M.S.) in Environmental Science, 20 years experience in laboratory analysis and applied environmental sciences.

Katherine A. Sheedy, P.G., Project Manager: M.S. in Geology, 10 years experience in geology and hydrogeologic investigations.

Mr. Walter M. Leis, P.G., Geotechnical Quality Assurance Officer: Corporate Vice President, M.S. in Geological Sciences, registered Professional Geologist, over 11 years experience in hydrogeology and applied geological sciences.

Mr. Robert J. Karnauskas, P.G., P.HG., Project Coordinator: M.S. degrees in both Hydrogeology and Water Resource Management, registered Professional Geologist and Hydrogeologist, over 8 years experience in hydrogeology and evaluation of subsurface contamination.

Mr. Jack Dowden, Project Geologist: M.S. in Hydrogeology, over 4 years experience in hydrogeology, geotechnical engineering and evaluation of subsurface contamination.

Dr. Earl Hansen, Laboratory Manager: Doctor of Philosophy (Ph.D.) in Chemistry, over 16 years experience in environmental sampling and analysis, including 3 years as laboratory quality assurance manager.

Mr. Harry M. Ricketts, Assistant Project Geologist: Bachelor of Arts in Geology, over 4 years experience in geological investigations and geotechnical engineering.

Mr. David M. Stein, Assistant Project Geologist: Bachelor of Science in Geology, over 2 years experience in hydrogeological and geotechnical investigations.

1.6.1 Subcontracting

The soil borings and installation of monitoring wells were completed by the Testing Engineers and Consultants, Inc., of Troy, Michigan. The survey of the monitoring well elevations and locations was performed by McMahon Engineers, of Detroit, Michigan.

SECTION 2

Environmental Setting

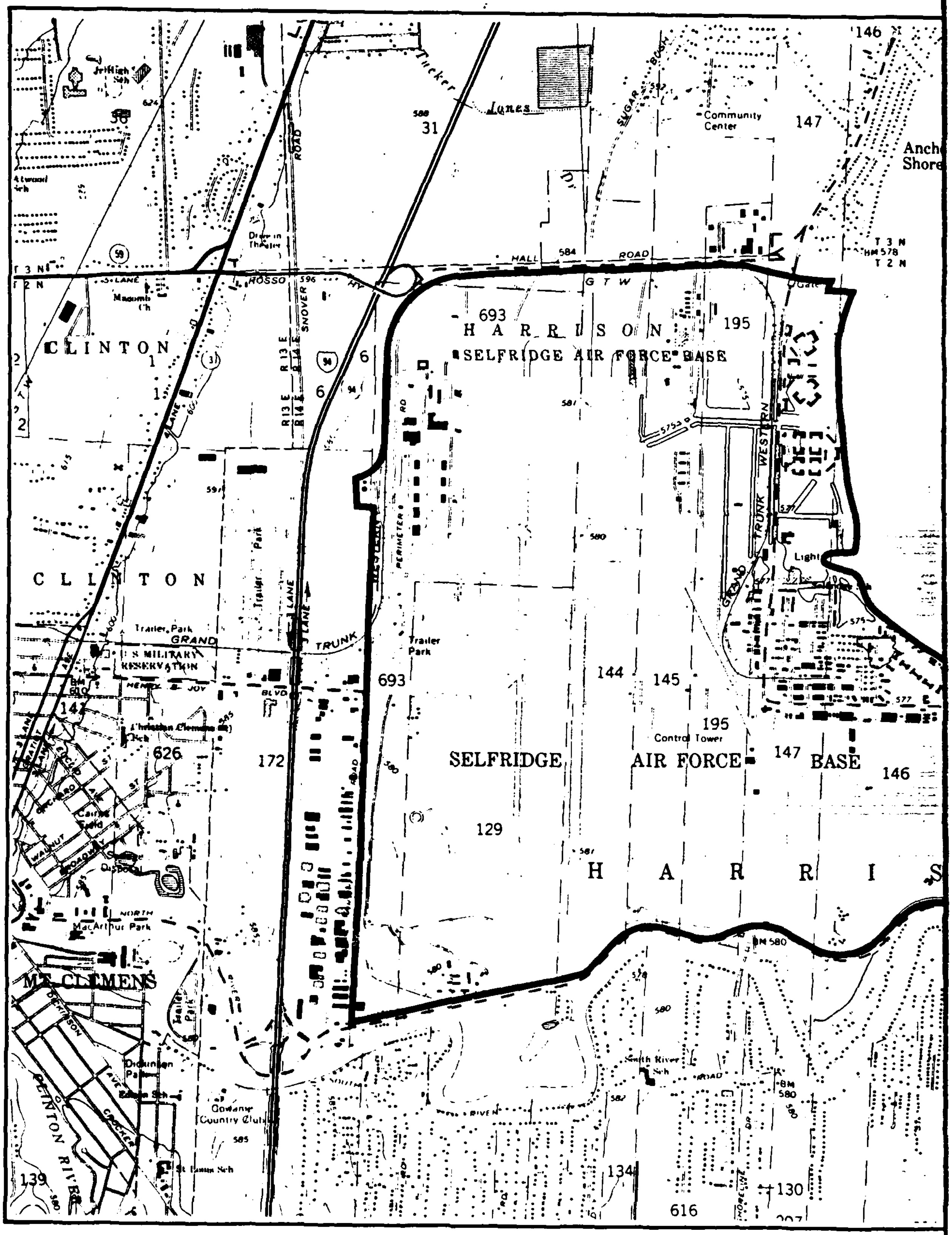
2.1 Geography

Selfridge ANGB is located in Macomb County Michigan on the northwestern shore of Lake St. Clair. The city of Mount Clemens Michigan lies approximately 2 miles to the west. The southern border of the Base adjoins North River Road which follows the Clinton River, flowing east and discharging to Anchor Bay of Lake St. Clair. Hall Road borders the Base on the north, (See Figure 2-1).

Selfridge ANGB occupies an area of approximately 3184 acres. The Base is located on glacial lake bed deposits of the ancestral Lake St. Clair when it stood at a high stage as the last of the Pleistocene glaciers melted. This depositional setting has resulted in a land surface of little relief, gently sloping eastward toward Lake St. Clair. The southeastern section of the Base lies on a peninsula which separates Anchor Bay from L'anse Creuse Bay to the south. The Clinton River meanders along the axis of the peninsula suggesting an alluvial origin for the peninsula.

Relief on the lake bed deposits results from natural and man-made surface drainage and the presence of two glacial lake paleo-shorelines or strandlines representing earlier, higher lake levels. These strandlines are reflected in the present topography as subdued ridges. The younger of the two strandlines is generally defined as the route of Sugarbush Road, which ends at the north edge of the Base. The route of Gratiot Avenue located west of the Base follows the older strandline. Drainage from the area is to Lake St. Clair via the Clinton River which discharges to the lake immediately south of the Base, and numerous other smaller rivers, streams, and drains which also flow directly to the lake.

Present Base topography results from the combination of the location on the lake bed or strand plain and cutting and filling operations conducted over the years. With the exception of a few small embankments associated with construction, maximum present relief on the Base is approximately 10 feet, between elevations of 585 feet mean sea level (MSL) at the extreme northwest corner of the Base to the present shoreline defined by the 575 foot msl mean lake elevation. These features are shown on Figure 2-1.


HARRISON
SELFRIDGE AIR FORCE BASE
CLINTON
MT. CLEMENS
HALL ROAD
Community Center
Anchor Shores
Control Tower
U S MILITARY RESERVATION
MacArthur Park
Clinton River
Gowanie Country Club
Trailer Park
Drive in Theater
GRAND TRUNK
SELFRIDGE AIR FORCE BASE
H A R R I S

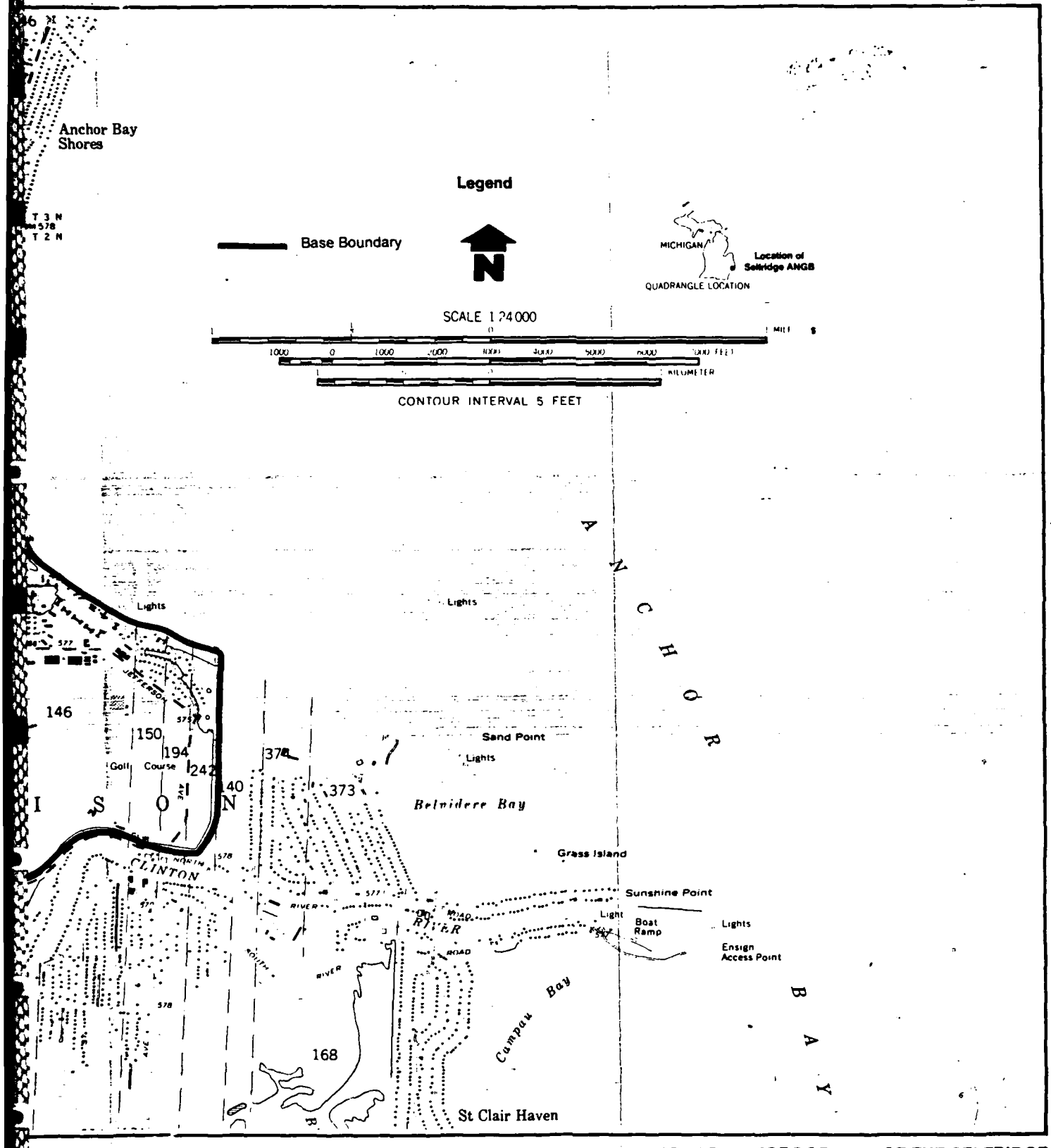


FIGURE 2–1 TOPOGRAPHY OF THE SELFRIDGE ANGB AREA

2 of 2

2.2 Drainage

Major portions of the Base are near the mean elevation of Lake St. Clair (approximately 575 feet msl). To protect the Base from flooding, an elaborate system of dikes, storm drains, ditches and lift stations, depicted in Figure 2-2, has been constructed. All drainage waters from the northern half and eastern edge of the Base are directed to Lake St. Clair. The remaining portion of the Base is drained southward to the Clinton River. Drainage from off-Base areas to the north and northwest is conveyed to Lake St. Clair via a man-made ditch constructed across the northeast corner of the Base. Numerous undrained depressions occur in the southwestern corner of the Base. These depressions are associated with past borrow material excavations.

2.3 Geology

The near surface geology at the Base is the result of Pleistocene age glaciation modified by post-glacial fluvial and lacustrine processes and the activities of man in support of Base operations. The Base is located in an area mapped as clay lake beds. These lacustrine sediments are overlain by two glacial lake strand plains which grade into glacial ground moraine deposits approximately one and one half miles west of the Base.

The depositional setting has resulted in primarily clayey glacial drift beneath the Base. As revealed by logs of numerous soil borings on Base and borings completed by WESTON during the Phase II field program, these clays contain variable and minor amounts of silty sand and gravel with occasional lenses of silty and sandy sediments. The presence of these coarser sediments suggests that the clays are not entirely lacustrine in origin, but probably represent till deposits associated with the ground moraine to the west.

Sand and/or fill material is found at or near the surface in some areas, mainly on the west side of the Base. The greatest thickness of surficial sand exists at the extreme southwest corner of the Base where sand has been logged from the surface to 24 feet below land surface (BLS). These surficial sands are probably derived from alluvial deposits of the Clinton River. The southern and southwestern portions of the Base lie in the meander belt of the Clinton River, as depicted in Figure 2-1. Sand deposits here tend

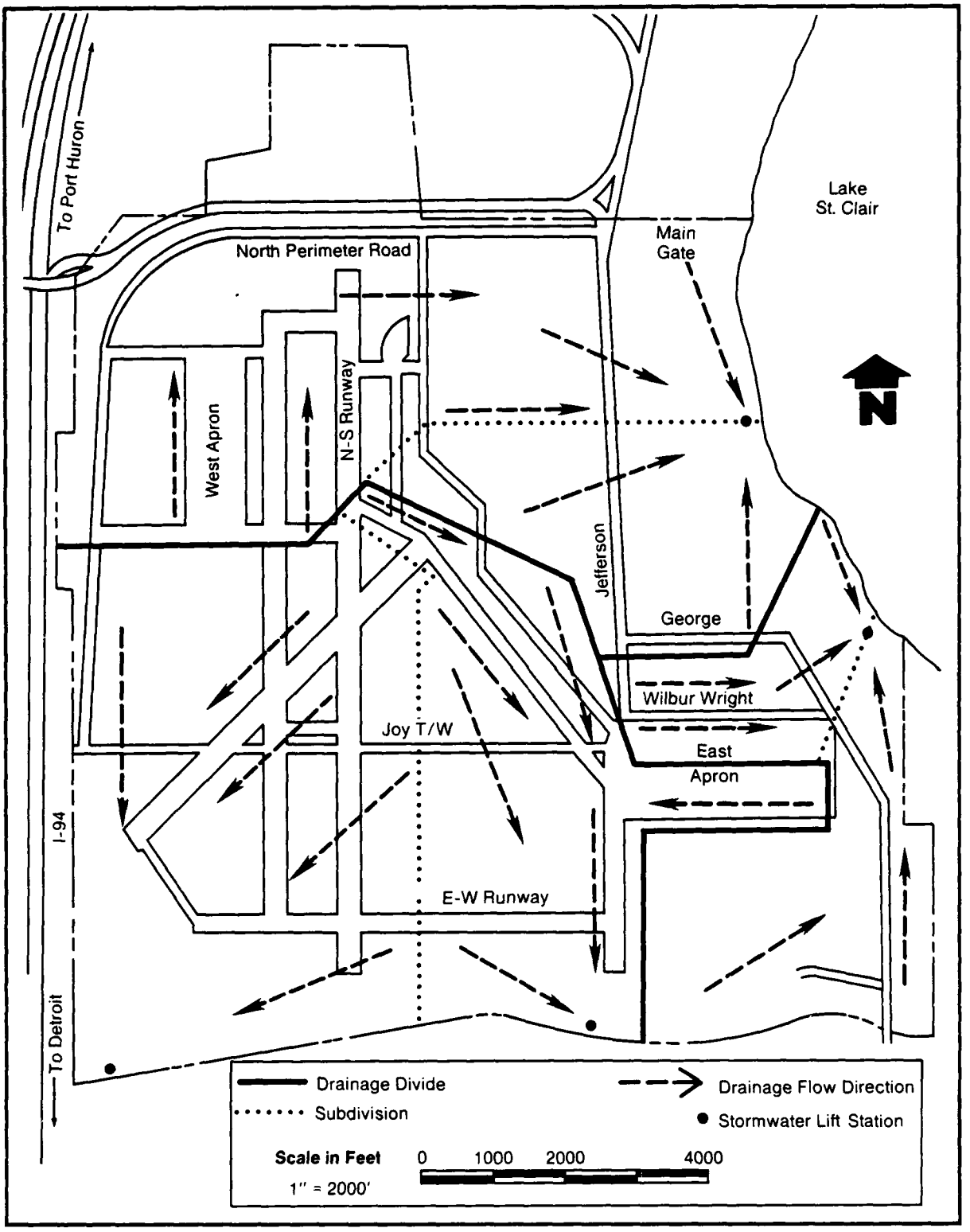


FIGURE 2-2 DRAINAGE PATTERN AT SELFRIDGE ANGB

to be discontinuous. Fill material derived from sand deposits has been emplaced to raise much of the Base to its current ground level elevation.

The glacial drift is unconformably underlain by the late Devonian System Antrium Shale at depths from less than 100 to approximately 150 feet BLS. The stratigraphic relationship between the drift and bedrock is shown on Figure 2-3. Two of the available logs from the Base have reported bedrock at approximate depths of 70 to 95 feet BLS. The log from domestic Well No. 4 reports black slate at 92 feet BLS. The Antrium Shale dips northeastward to form part of a bowl shaped depression known as the Michigan Basin. Selfridge ANGB lies on the southeastern flank of this bedrock structure.

The Antrium Shale is a cinnamon brown to black and dark gray bituminous shale which is thin bedded to fissile. It has a range in thickness from 120 feet where it is cut by Pleistocene erosion to 600 feet in portions of northeast Michigan (Geological Survey Division, Michigan, Department of Natural Resources, 1978).

The USDA soils maps for the area of the Base reveal that the dominant soil type is "made land" i.e., fill material. Virtually all of the runway and aircraft handling areas have apparently been filled. The remainder of the Base (small isolated areas around the perimeter of the Base) is covered by clay soils of the Toledo or Paulding series, reflecting the old lake bed. Exceptions to this are areas of sandy soils at the northeast and southwest corner of the Base and are related to the glacial lake strand line. Some of the sand at the southwest corner may be the result of alluvial processes associated with the Clinton River. Sandy loams at the southeast corner and south edge of the Base may also be related to these alluvial processes.

2.4 Hydrogeology

Groundwater resources in the study area have been shown to be adequate for domestic water supply but marginal for any significant supply. Typical yields from wells installed into the glacial drift and bedrock are less than 10 gallons per minute (GPM). Wells installed into the glacial drift tap sand and gravel lenses of limited areal and vertical extent; groundwater in these lenses generally occurs under confined conditions. Groundwater obtained from the Antrium Shale and underlying Traverse Formation is known to be highly mineralized, containing chlorides in excess of recommended limits. This mineralization also apparently im-

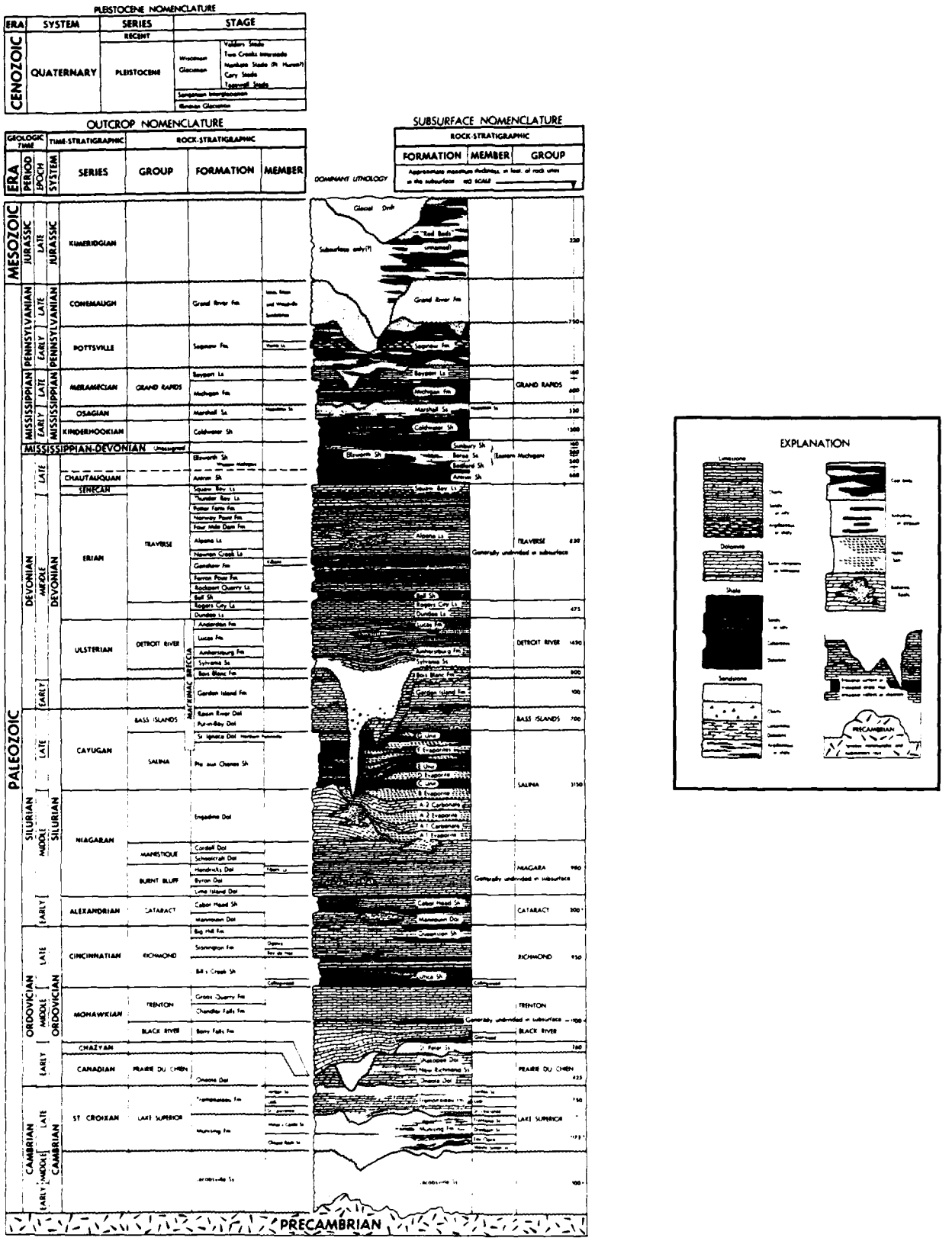


FIGURE 2-3 STRATIGRAPHIC SUCCESSION IN MICHIGAN

pacts the overlying glacial drift. Some wells completed in the drift also produce water with elevated levels of chloride, as well as magnesium, sodium, and potassium, suggesting upward groundwater movement into the drift from the bedrock.

The shallowest water-producing sand and gravel lenses beneath the Base occur between 20 and 60 feet BLS. The greatest concentration of these lenses occurs at the northwest corner of the Base where several borings reported sandy intervals up to 5 feet thick at depths ranging from 22.5 to 33.5 feet BLS. The fact that these sands are absent in other borings suggests that they do not represent a continuous stratum. The deposition of these sand bodies may be related to the glacial lake strand line.

A second potential shallow aquifer is associated with the sands encountered in the borings installed in the southwestern portion of the Base. These sands are deposited at the ground surface along the Clinton River channel and constitute a usable aquifer. Several driller logs from domestic water-supply wells installed immediately south of the Base indicate that this shallow sand body was encountered off-base.

Underground utilities such as waterlines, sewers, electric and telephone conduits are usually backfilled with sand to facilitate drainage. These backfilled trenches are capable of collecting groundwater and transmitting it if an outlet exists. Extensive areas of the Base are underlain by drain tiles and the sanitary sewer system on Base is known to collect significant infiltration of groundwater. Both of these systems are subject to impact from any contamination present in the shallow groundwater.

Due to the low permeability and continuous nature of the glacial clays underlying the Base, the main path of migration for fluids placed on or in the ground is laterally to surface water bodies. The storm sewer drainage collected at the Base flows to a number of lift stations which discharge directly to Lake St. Clair or to the Clinton River.

2.5 Hydrology

The surface water hydrology at Selfridge ANGB is largely controlled by its close proximity to Lake St. Clair. All Base drainage is ultimately conveyed to Lake St. Clair either naturally or by lift stations which pump Base

drainage and effluent to the Clinton River or Lake St. Clair.

Although the Base is very close to the Clinton River, North River Road, which envelops the south boundary of the Base, has been identified as a drainage divide, separating the Base from the Clinton River Drainage Basin. All natural drainage from the Base is directed to Lake St. Clair.

SECTION 3

Field Investigation

3.1 PROGRAM DEVELOPMENT

Task Order 0049 was issued on the basis of the Phase I report recommendations and WESTON's Phase II pre-survey site inspection and report.

Sub-section 3.1 describes the approved field investigation programs for all seven areas considered in this Phase II Problem Confirmation Stage I study. Sub-section 3.2 describes the field activities and the methodologies used to conduct these activities.

3.1.1 Purpose of Field Investigation

The purpose of the Phase II Stage 1 Problem Confirmation Study is to confirm the presence or absence of contaminants at those sites identified in the Phase I records search, and other sources, as having the greatest potential for environmental contamination by hazardous materials. Efforts to assess the vertical and horizontal extent of contamination, to quantify the amount of contaminant residuals in the subsurface, or to estimate the rate of contaminant migration, are topics for more intensive and site-specific Stage 2 investigations. These investigations are only undertaken when environmental contamination is confirmed to exist during Stage 1.

3.1.2 Specific Requirements

3.1.2.1 Site No. 1, Southwest Sanitary Landfill (SSL)

The Phase I report recommended drilling three test bores, each drilled until groundwater was encountered. One test bore was to be located upgradient of expected groundwater flow (west), one within the site, and one downgradient of the expected groundwater flow (east). Soil samples were to be taken at ground level and at two foot intervals until perched water was reached. Groundwater was to be analyzed for the parameters listed in Table 1-3.

The WESTON pre-survey report concurred and made further recommendations as follows:

- One groundwater monitoring well to be established on the west side of the facility anticipated to be

upgradient, one well within the facility, and one well within the east perimeter of the facility anticipated to be downgradient.

- Survey elevations of all monitor wells and obtain at least three rounds of water level measurements.

- Obtain one round of samples from all monitor wells for water quality analysis as shown in Table 1-3.

The approved scope of work included the WESTON Phase II pre-survey modifications and increased the number of groundwater monitoring wells to four, one to be located along each perimeter of the landfill area on the north, south, east and west. Also, the number of water quality samples to be collected was increased to include three ponded surface water samples within and adjacent to the landfill. Water quality samples were to be analyzed for the parameters listed in Table 1-3. Each monitoring well was to be drilled to a depth of 25 feet BLS and screened for 20 feet below the water table.

3.1.2.2 Site No. 2, Fire Training Area-2 (FTA-2)

The Phase I report recommended drilling three test bores, each drilled until groundwater was encountered. One test bore was to be located upgradient (west) of the expected groundwater flow, one test bore within the site, and one test bore downgradient of the expected groundwater flow (east). Soil samples were to be taken at ground level and at two foot intervals until perched water was encountered, and at five foot intervals thereafter. Groundwater was to be analyzed for the parameters listed in Table 1-3.

The WESTON pre-survey report concurred and made further recommendations as follows:

- Drill and construct three monitoring wells in the Fire Training Area. One well to be located west of the site, one well within the site and one well east of the site.

- Survey elevations of all monitoring wells and obtain at least three water level measurements.

- If during sampling hydrocarbons were observed in the monitoring well, the thickness of the hydrocarbons on the water table was to be estimated.

- Obtain one round of samples from all monitor wells for water quality analysis as shown in Table 1-3.

The approved scope of work included the WESTON Phase II pre-survey recommendations and made further modifications. The recommended monitoring well within the site was to be relocated to the east side of the Fire Training Area-2, providing two downgradient monitoring well locations. A maximum of two surface water samples were to be collected for analysis; one of the ponded water within the bermed Fire Training Area and one downstream location near the discharge of the drain pipe (originating within the berm) into the drainage swale. All water quality samples were to be tested for the parameters listed in Table 1-3. Each monitoring well was to be drilled to a depth of 25.0 feet BLS and screened for 20 feet below the water table.

3.1.2.3 Site No. 3, Fire Training Area-1 (FTA-1)

The Phase I report recommended drilling three test bores, each drilled until groundwater was encountered. One test bore was to be drilled upgradient of the expected groundwater flow (west), one within the site, and one downgradient of the expected flow (east). Soil samples were to be taken at ground level and at two foot intervals thereafter. Groundwater was to be analyzed for the parameters listed in Table 1-3.

The WESTON pre-survey report concurred and made further recommendations as follows:

- Drill and construct three monitoring wells in the Fire Training Area. One well to be located west of the site, one well within the site, and one well east of the site.

- Survey elevations of all monitoring wells and obtain at least three water level elevation measurements. If during sampling, hydrocarbons were observed in the monitoring well the thickness of the hydrocarbons was to be estimated.

- Obtain one round of samples from all monitoring wells for water quality analysis of the parameters listed in Table 1-3.

The approved scope of work included the WESTON Phase II pre-survey recommendations and made further modifications. The recommended monitoring well within the site was to be

relocated to the east side of the Fire Training Area-1, providing two downgradient monitoring well locations. All water quality samples were to be analyzed for the parameters listed in Table 1-3. Each monitoring well was to be drilled to a depth of 25.0 feet BLS and screened for 20 feet below the water table.

3.1.2.4 Site No. 4, West Ramp (WR)

The Phase I report recommended drilling three test bores, each drilled until groundwater was encountered. One test bore was to be drilled upgradient of the expected groundwater flow (west), one within the site, and the third downgradient of the expected groundwater flow (east). Soil samples were to be taken at ground level and at two foot intervals until groundwater was encountered, the groundwater analyzed for the parameters listed in Table 1-3.

The WESTON pre-survey report concurred and made the following recommendations:

- Drill and construct three monitoring wells within the area of the West Ramp. One well to be located west of the fuel ramp, one well through the ramp, and one well east of the fuel ramp.
- Survey elevations of all monitoring wells and measure water level elevations semi-weekly over the period of WESTON's on-site activities. If hydrocarbons were observed in the monitoring wells, the thickness of the hydrocarbons was to be estimated.
- Obtain one round of water quality samples from the monitoring wells to be analyzed for the parameters listed in Table 1-3.

The approved scope of work included the WESTON Phase II pre-survey recommendations and made further modifications. The number of monitoring wells to be installed at this site was increased to five:

- One well near the northeast corner of the west ramp.
- One well near the northwest corner of the west ramp.
- One well near the southeast corner of the west ramp.

- One well at the southwest corner of the west ramp within the area of the January 1984 fuel spill.

- One well east of the west ramp along the buried fuel line near the fuel valve pit where the January 1984 release occurred.

During the process of monitoring well installation, soil samples were to be collected at 2.5 foot intervals for the first ten feet and at five foot intervals thereafter. WESTON was to select three of the soil samples from each borehole for analysis. The remaining soil samples were to be archived frozen (for possible future analysis) until completion of the contract effort. The 15 soil samples selected by WESTON were to be analyzed for the parameters listed in Table 1-3. The groundwater samples from each monitoring well were to be analyzed for the parameters listed in Table 1-3.

All monitoring wells were to be drilled to a depth of 25.0 feet (BLS) and screened for 20 feet below the water table.

3.1.2.5 Site No. 5, Tucker Creek Landfill (TCL)

The Phase I report recommended drilling three test bores at this site, each to be drilled until groundwater was encountered. The locations of the test bores were to be as follows: one test bore to be drilled upgradient of the expected groundwater flow (west), one within the site, and one down gradient of the expected groundwater flow (east). Soil samples were to be taken at ground level and at two foot intervals until groundwater was encountered. Groundwater was to be sampled for the parameters listed in Table 1-3.

The WESTON pre-survey report concurred and made the following recommendations:

- Drill and construct three groundwater monitoring wells in the landfill area; one well west of the landfill, one well within the site, and one well east of the landfill.

- Survey elevations of all monitoring wells and obtain at least three water level elevation measurements.

- Obtain one round of groundwater samples from all monitoring wells to be analyzed for the parameters listed in Table 1-3.

The approved scope of work included the WESTON Phase II recommendations and one modification. The pre-survey monitoring well to be located within the landfill was to be relocated to the east side of the landfill yielding two downgradient monitoring wells. The groundwater monitoring wells were to be drilled to 25.0 feet (BLS) and screened for 20 feet below the water table.

3.1.2.6 Site No. 6, Northwest Landfill (NL)

The Phase I report recommended drilling three test bores at the Northwest Landfill, each drilled until groundwater was encountered. One test bore was to be located upgradient of the expected groundwater flow (west), one located within the site, and one located downgradient of the expected groundwater flow (east). Soil samples were to be taken at ground level and at two foot intervals thereafter. Groundwater was to be sampled and analyzed for the parameters listed in Table 1-3.

The *WESTON pre-survey report further recommended* the following actions:

- Drill and construct three groundwater monitoring wells; one well located west of the landfill, one well within the landfill, and one well east of the landfill.

- Survey elevations of all monitoring wells and obtain at least three water level elevation measurements.

- Obtain one round of water quality samples to be analyzed for the parameters listed in Table 1-3.

The approved scope of work included the WESTON Phase II pre-survey recommendations and made one further modification. The monitoring well located within the landfill was to be relocated to the east side of the landfill,yielding two downgradient monitoring wells. Groundwater samples obtained from the three wells were to be analyzed for the parameters listed in Table 1-3. The monitoring wells were to be drilled to 25.0 feet (BLS) and screened for 20 feet below the water table.

3.1.2.7 Site No. 7, East Ramp (ER)

The Phase I report recommended drilling three test bores at East Ramp Fuel Spill, each drilled until groundwater was encountered. One test bore was to be drilled upgradient of the expected groundwater flow (west), one within the site, and one downgradient of the expected groundwater flow (east). Soil samples were to be taken at ground level and at two foot intervals thereafter. When groundwater was encountered, it was to be sampled and analyzed for the parameters listed in Table 1-3.

The WESTON Phase II pre-survey report further recommended the following actions:

- Drill and construct three groundwater monitoring wells to be located as follows: one well west of the ramp, one well through the ramp, and one well east of the ramp.
- Survey elevations at all monitoring wells and obtain at least three water level elevation measurements from each well. If hydrocarbons were observed in the monitoring wells, the thickness of the hydrocarbons on the water table was to be estimated.
- Obtain one round of water quality samples from all monitoring wells to be analyzed for the parameters listed in Table 1-3.

The approved scope of work included the WESTON Phase II pre-survey recommendations and increased the number of monitoring wells to four. The wells were to be located as follows:

- One well adjacent to and near the northwest portion of the east ramp.
- One well adjacent to and near the northeast portion of the east ramp.
- One well adjacent to and near the southwest portion of the east ramp.
- One well adjacent to and near the southeast portion of the east ramp.

During the process of monitoring well installation soil samples were to be collected from each of the four wells at

2.5 foot intervals for the first 10 feet and at five foot intervals thereafter. Three soil samples from each well (12 total) were to be selected for analysis of the parameters listed in Table 1-3. The remaining soil samples were to be archived frozen (for possible future analysis) until completion of the contract effort.

The four groundwater monitoring wells were to be drilled to a depth of 25 feet (BLS) and screened for 20 feet below the water table.

3.1.3 Critical Assumptions

The proposed scope of work contained in the WESTON Phase II presurvey Report, and the subsequent implementation of methodology, was based to a large degree on the following assumptions:

- Selfridge ANGB appears to be underlain by a continuous layer of low permeability lacustrine and glacial clays. At some locations however, this low permeability zone is underlain and overlain by a somewhat discontinuous sandier and more permeable stratum.

- Due to the continuous nature and low permeability of these clays, fluids placed on or in the ground or those leached from solid materials are transported laterally to surface water bodies.

- All surface drainage is ultimately conveyed to Lake St. Clair.

- Underground utilities such as water, sewer, electric and telephone lines are usually backfilled with sand to facilitate drainage and minimize frost damage. Groundwater collects in such trenches and, if an outlet exists, will transmit flow. The sanitary sewer system at the Base is known to collect significant infiltration of shallow groundwater.

- Shallow, potential aquifers of local extent occur in the vicinity of the northwest and southwest corners of the Base. Sands and gravels occurring 20 to 65 feet (BLS) in the northwest do not appear to be of significant areal or vertical extent but probably yield enough water for domestic supply. Alluvial sands in the southwest occur at the

surface and may be directly affected by Base activities. These sands appear to extend for several thousand feet beyond the Base boundaries, and are believed to be hydraulically connected to the Clinton River.

- o The dominant soil type at the Base is "made land" or fill material. Virtually all of the runway and aircraft handling areas have apparently been filled.

3.1.4 Analytical Protocol

The analytical protocol summarized in Table 1-3 was selected for the seven sites addressed in the Phase II study. The parameters chosen are specific and non-specific indicators of contamination.

3.1.5 Formal Scope of Work

Task Order 0049 formalized the work proposed in the WESTON Phase II pre-survey report and is included in Appendix B. Task Order 0049 provided the basis for the implementation of the field program described in Sub-section 3.2.

3.2 HYDROGEOLOGIC INVESTIGATION

A field investigation was conducted to define the hydrogeologic and geologic setting at Selfridge ANGB and to evaluate the presence of hazardous environmental contaminants that may have resulted from past product storage and handling practices or waste disposal operations at the Base. Information regarding potential or actual impacts of the seven sites on area groundwater was obtained from a total of 25 on-site monitoring wells, nine soil borings, and five surface water locations.

During the drilling of the monitoring wells split-spoon samples were taken at specified 2.5 and 5 foot intervals to obtain representative samples of the unconsolidated sediments in the unsaturated and saturated zones for visual inspection. Soil samples from nine of the monitoring well locations were collected during drilling for laboratory analysis. The wells also provided measuring points for determining ground water levels and thereby facilitating the assessment of hydraulic gradients and configuration of the potentiometric surface at Selfridge ANGB. A twenty foot length of 2-inch, inside diameter, stainless steel well screen was installed in each boring. This screen was to be

installed to 20 feet below the water table regardless of the site hydrostragigraphy. Difficulties arose in fullfilling this requirement since the ground water was encountered under water table conditions at only two of the seven investigation sites. Therefore, a decision was made early in the drilling program to set the top of the well screens at a depth of 2 to 5 feet from the land surface. By applying this criteria to all the wells it was felt that the lighter than water fraction (i.e. the petroleum hydrocarbons) would be intercepted, if present, and the water level readings would be generally comparable. The field work is summarized on a site-by-site basis in Table 3-1.

3.2.1 Schedule of Activity

The field investigation of Selfridge ANGB commenced on 2 November 1984 and was completed in June 1985. A summary of WESTON's field investigation schedule at Selfridge ANGB is presented in Table 3-2.

3.2.2 Drilling Program

The drilling program at Selfridge ANGB included the installation of 25 monitoring wells and collection of 27 soil samples. All of the groundwater monitoring wells were completed within the unconsolidated glacial drift. The drilling was accomplished by the drill crews of Testing Engineers and Consultants, Inc., Troy, Michigan. A Central Mining Equipment (CME) Model 45 was used to drill and construct all of the monitoring wells.

Representative soils samples were taken at selected 2.5 and 5 foot intervals throughout the unconsolidated glacial drift with split-spoon samplers using Standard Penetration Test (SPT) procedures in accordance with ASTM Test D-1586. Boring logs were prepared concurrent with the drilling and sampling. These logs are presented in Appendix D. Except for soil samples obtained for laboratory analysis, all others obtained during drilling were preserved in glass jars for later examination. The geotechnical descriptions and classifications of each sample were determined by a WESTON on-site geologist utilizing visual and textural examination techniques. These classifications were later corroborated by a WESTON geologist who checked the field logs against the samples which were preserved in glass jars. There was no attempt to interpret the drill cuttings which were returned to the surface or which stuck to the augers to determine the soil characteristics in the intervals between the split-spoon samples. An HNu photoionization meter was used

TABLE 3-1

SUMMARY OF FIELD INVESTIGATION
SELFRIDGE ANGB

Site	Activity
Southwest Sanitary Landfill	Installed four groundwater monitoring wells into the unconsolidated formation. Selected three ponded surface water locations; two within the SSL and the other west of the SSL. Sampled and analyzed for VOA, TOC, phenols, COD, metals*, oil and grease. Performed well and water table elevation surveys.
Fire Training Area-2	Installed three groundwater monitoring wells into the unconsolidated formation. Selected two ponded surface water locations within the FTA-2. Sampled and analyzed for VOA, TOC, phenols, and petroleum hydrocarbons. Performed well and water table elevation surveys.
Fire Training Area-1	Installed three groundwater monitoring wells into the unconsolidated formation. Sampled and analyzed for VOA, TOC, phenols and petroleum hydrocarbons. Performed well and water-table elevation survey.
West Ramp Fuel Spill and January	1984 Spill Site nstalled five groundwater Monitoring wells into the unconsolidated formation. Sampled and analyzed for VOA, TOC, and petroleum hydrocarbon. Fifteen soil samples (three from ach well) were collected during drilling and analyzed for VOA and Oil and Grease. Performed well and water-table elevation surveys.

TABLE 3-1
(continued)

Site	Activity
Tucker Creek Landfill	Installed three groundwater monitoring wells into the unconsolidated formation. Sampled and analyzed for VOA, TOC, phenols, COD, metals*, oil and grease. Performed well and water-table elevation surveys.
Northwest Landfill	Installed three groundwater monitoring wells into the unconsolidated formation. Sampled and analyzed for VOA, TOC, phenols, COD, metals*, oil and grease. Performed well and water table elevation surveys.
East Ramp Fuel Spill	Installed four groundwater monitoring wells into the unconsolidated formation. Sampled and analyzed for VOA, TOC, and petroleum hydrocarbon. Collected twelve soil samples (three from each well) during drilling and analyzed for VOA and Oil and Grease. Performed well and water-table elevation surveys.

* Metals include: Cadmium, Chromium, Copper, Lead, Nickel, and Zinc.

TABLE 3-2

SCHEDULE OF FIELD INVESTIGATION ACCOMPLISHMENTS
SELFRIDGE ANGB

Date	Activity
2 November 1984	Pre-construction visit to locate well sites and meet with Base officials
21 January 1985 - 2 February 1985	Drilling, construction and development of groundwater monitoring wells
5-11 March 1985	Sampling of all surface and groundwater monitoring points except monitoring wells W-1 and W-2. Measurement of groundwater levels
17-18 April 1985	Sampling of monitoring wells W-1 and W-2. Measurement of groundwater levels
10-11 May 1985	Resampling of monitoring wells W-3 through W-25 for volatile organic analysis
11-12 June 1985	Measurement of groundwater levels
June 1985	Surveying location and elevation of groundwater monitoring wells

to evaluate the presence or absence of organic vapors emanating from each soil sample. The drill cuttings that were found to be contaminated, on the basis of HNu photo-ionization readings, were isolated, marked and sampled for EP toxicity and ignitability analysis. All other cuttings were disposed of by Base Civil Engineering personnel.

3.2.2.1 Monitoring Well Construction

The groundwater monitoring wells were constructed by advancing a 3.25 x 8 inch hollow stem auger to the required depth (25 feet BLS). Then 20 feet of 2-inch diameter Western Well 0.010-inch continuous slot, stainless steel, flush-thread well screen and the appropriate length of 2-inch diameter schedule 40 PVC riser were assembled and inserted through the auger stem. No solvents or glues were used on any of the casing or screen couplings. The augers were then pulled up (not screwed out) to several feet above the screen as the sand filter pack (No. 2 medium sand) was poured into the annular space between the well pipe and the auger stem. The augers were then withdrawn from the well. The sand filter pack was then poured into the annular space between the well pipe and the borehole to at least 5 feet above the top of the well screen. Bentonite pellets were subsequently placed on top of the filter pack to seal the screened interval from fluid migration through the annular space. The seal was completed by pouring Type 1 Huron ^{R}, Portland cement grout over the PVC riser pipe. Running sands and low strength silts were encountered in several of the wells. These materials would often collapse around the well screen before the filter pack could be installed. Several attempts were made to auger or wash these materials out of the borehole; however, this usually increased the instability of the borehole walls and resulted in the collapse of additional materials.

All of the groundwater monitoring wells were developed by bailing until a sand-free fluid was produced. Due to the predominantly silt/clay nature of the glacial drift formation all wells generally produce a cloudy fluid toward the bottom of the wells.

A schematic of the monitoring well construction is presented in Figure 3-1. The locations of the monitoring wells are shown in Figure 3-2. Individual well completion details and well logs are presented in Appendix D and in Table 3-3. Graphic summaries of well construction at each site are presented on Figures 3-3 through 3-6 in discussion of site specific investigations in Section 3.3

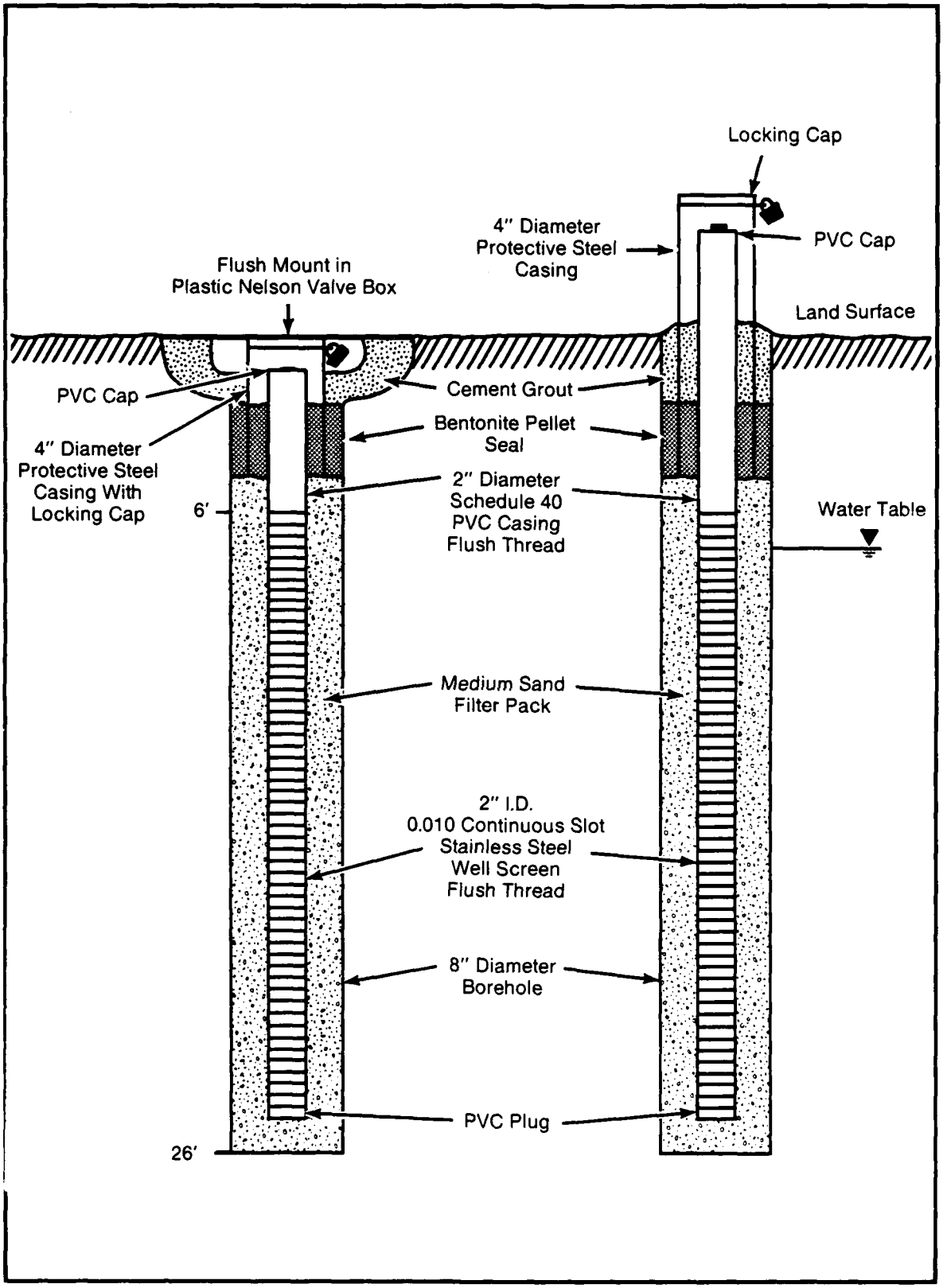


FIGURE 3-1 SCHEMATIC OF MONITORING WELL CONSTRUCTION

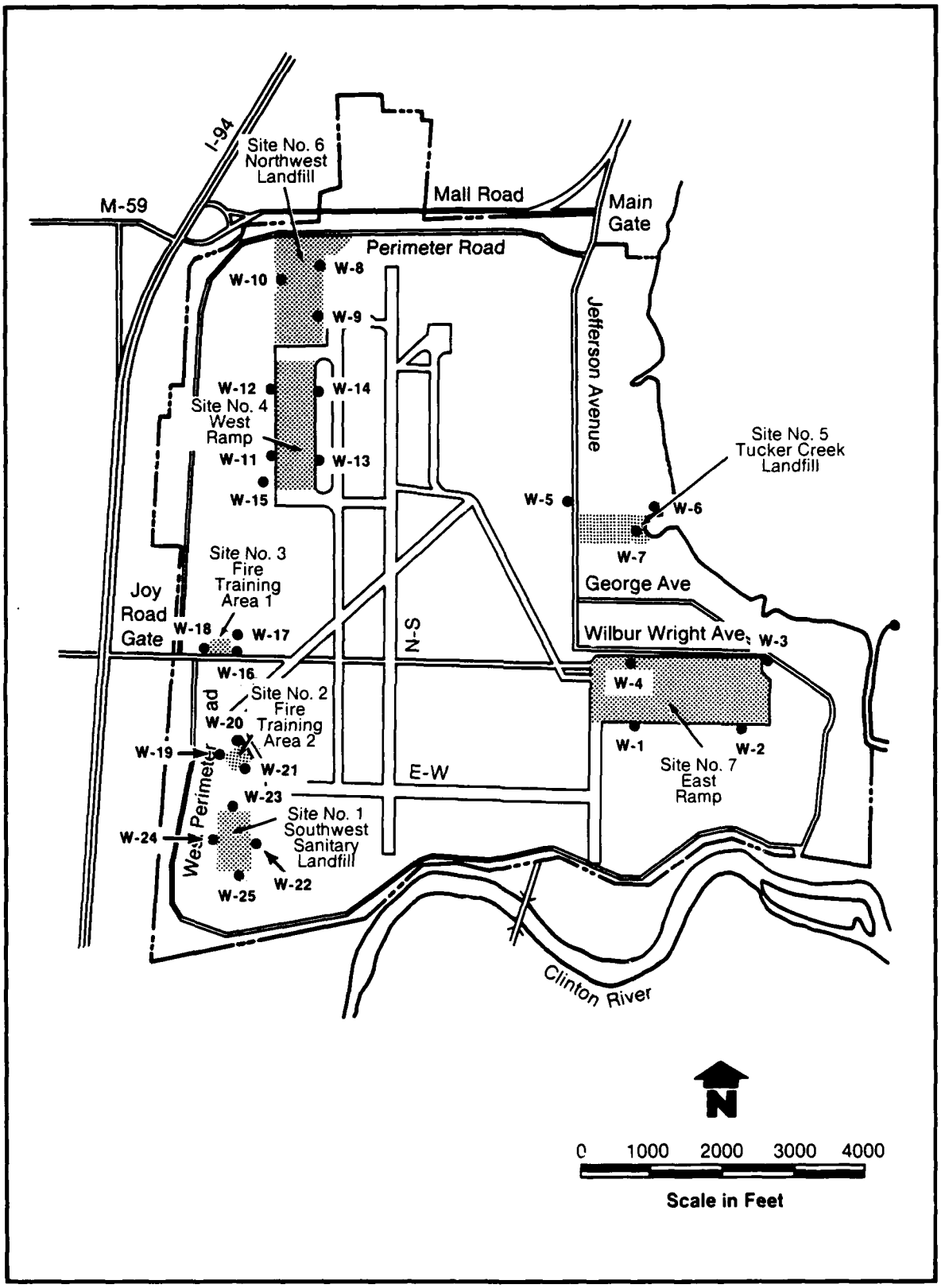


FIGURE 3-2 LOCATIONS OF GROUNDWATER MONITORING WELLS

TABLE 3-3
SUMMARY OF MONITORING WELL CONSTRUCTION DETAILS
SELFRIDGE ANGB

Site	Monitor Well Number	Land Surface Elevation (feet MSL)	Elev of Top of Riser Casing (feet MSL)	Screen/Open Hole Interval Depth (feet BLS)	Sand Pack Interval Depth (feet BLS)	Description of Prominent Lithology
ERFS	W-1	576.50	575.82	6.0 - 26.0	4.0-26.0	Light brown to medium gray, clay, massive plastic to very plastic. Light brown silty fine sand at or near surface with minor faint bedding and orange discoloration, 1.0 - 5.0 feet BLS.
	W-2	576.34	575.36	6.0 - 26.0	3.8 - 26.0	Brown grading to medium gray, clay, massive, fat, slightly to very plastic. Light brown fine sand, massive, firm, trace orange mottling, 1.0 - 5.0 feet BLS.
	W-3	575.01	575.34	6.0 - 26.0	4.0 - 26.0	Brown grading to blue gray, clay, massive, slightly to very plastic. Black to light brown silty fine sand, minor gravel, massive, firm to hard, 1.0 - 5.0 feet BLS.
	W-4	575.87	575.67	5.5 - 25.5	4.3 - 25.5	Brown to gray, clay, massive, plastic to very plastic, fat. Dark brown, clayey fine sand, massive, firm, 1.0 - 5.0 feet BLS. From 24.8 - 25.0 feet BLS, silty gravelly sand zone.
TCL	W-5	579.85	578.91	6.0 - 26.0	3.25 - 26.0	Bluish gray grading to gray, clay, massive, plastic to very plastic, soft, occasionally silty. Yellow brown clayey fine sand 1.0 - 5.0 feet BLS.
	W-6	577.24	579.06	5.0 - 25.0	4.0 - 25.0	Brown, silty clay, dominantly massive, occasional faint bedding, slightly to very plastic, minor mottling 9.5 - 11.0 feet BLS. Decrease of fine sand and gravel intercalated with silty clay 19.5 - 25.0 feet BLS. Brown, clayey silty sand 4.5 - 6.0 feet BLS.
	W-7	576.51	576.36	5.5 - 25.5	3.5 - 25.5	Brown, clay, massive, plastic to very plastic, soft. Brown silty fine sand topsoil with minor gravel. Bluish gray silty sand, massive, soft, grading to wet stiff massive sandy clay with minor gravel 23.5 - 25.0 feet BLS.
NWL	W-8	587.14	589.09	6.0 - 26.0	4.0 - 26.0	Dark gray to brownish gray, clay, massive, slightly to very plastic, soft. Dark brown silty fine sand topsoil, massive, trace orange staining.

TABLE 3-3 (cont.)

Site	Monitor Well Number	Land Surface Elevation (feet MSL)	Elev of Top of Riser Casing (feet MSL)	Screen/Open Hole Interval Depth (feet BLS)	Sand Pack Interval Depth (feet BLS)	Description of Prominent Lithology
NWL	W-9	581.01	583.66	6.0 - 26.0	4.0 - 26.0	Brown, clay, massive, plastic to very plastic soft, soupy at 25.0 feet BLS. Black silty sand topsoil. Olive brown soupy silty fine sand 4.5 - 6.0 feet BLS.
	W-10	581.76	580.67	6.0 - 26.0	4.0 - 26.0	Brown grading to olive gray, clay, occasionally silty, massive, plastic to very plastic, soft. Black organic fine sand topsoil. Silty gravelly sand intercalated with clay 23.5 - 25.0 feet BLS.
WRPS	W-11	578.83	578.45	5.5 - 25.5	3.5 - 25.5	Dark brown to grayish brown, clay, occasionally silty, faintly bedded to massive, very plastic. Brown silty fine sand with faint bedding intercalated with clay 1.0 - 7.5 feet BLS. Gray silty clayey fine sand with gravel, massive, very plastic 23.5 - 25.0 feet BLS. Hnu readings of 300 ppm.
	W-12	582.15	581.69	5.5 - 25.5	3.5 - 25.5	Blue gray, clay, occasionally silty, massive, slighty to very plastic, trace mottling. Brownish gray to bluish gray clayey silty sand, faintly bedded, slightly plastic 1.0 - 5.0 feet BLS. Brownish gray silty fine sand 23.5 - 25.0 feet BLS.
	W-13	581.66	581.07	6.0 - 26.0	3.5 - 26.0	Brown to brown gray, clay, intercalated with silt and fine sand, faintly bedded to massive, slightly to very plastic. Fine sand zone occurs at 25.0 feet BLS.
	W-14	581.94	581.43	6.0 - 26.0	3.5 - 26.0	Gray, clay, massive, plastic to very plastic. Brown, silty fine sand, massive to faintly bedded intercalated with clay 1.0 - 7.5 feet BLS. Silty sand with minor gravel intercalated with clay 23.5 - 25.0 feet BLS.
	W-15	582.79	584.75	5.6 - 25.6	4.0 - 25.6	Blue gray to gray, clay, faintly bedded to massive, slightly to very plastic, distinct mottling 3.5 - 7.5 feet BLS. Strong petroleum odor at surface to 5.0 feet BLS. Hnu readings of 260 ppm.

TABLE 3-3 (cont.)

Site	Monitor Well Number	Land Surface Elevation (feet MSL)	Elev of Top of Riser Casing (feet MSL)	Screen/Open Hole Interval Depth (feet BLS)	Sand Pack Interval Depth (feet BLS)	Description of Prominent Lithology
FPTA-1	W-16	577.47	579.61	6.0 - 26.0	3.5 - 26.0	Gray, clay, massive, plastic, discoloration 4.5 - 6.0 feet BLS. Dark brown silty clay topsoil.
	W-17	577.87	579.96	6.0 - 26.0	4.0 - 26.0	Light brown grading to gray, clay, massive, very plastic. Discolored with bluish green clay 9.5 - 11.0 feet BLS.
	W-18	578.15	580.27	5.7 - 25.7	4.0 - 25.7	Light brown to light gray, clay, massive, plastic blue green discoloration 4.5 - 6.0 feet BLS.
FPTA-2	W-19	580.40	582.37	6.0 - 26.0	4.0 - 26.0	Dark gray to light brown, clay, massive, slightly to very plastic. Light brown, silty clayey sand lens at 14.5 feet BLS, grades to a gray fat highly plastic clay.
	W-20	579.37	Destroyed	6.0 - 26.0	4.0 - 26.0	Olive gray to gray, clay, massive, plastic to very plastic. Petroleum product present in topsoil and to a depth of 6.0 feet BLS. Hnu readings of 70 ppm.
	W-21	579.55	581.46	6.0 - 26.0	4.0 - 26.0	Brown to gray, clay, massive, slightly plastic. Petroleum odor present in topsoil and to a depth of 5.4 feet BLS. Hnu readings of 50 - 70 ppm.
SSL	W-22	582.60	584.63	5.0 - 25.0	5.0 - 25.0	Blue gray to gray, silty clay to fat clay, massive plastic to very plastic. Yellow brown, well sorted fine sand grading to a silty clay 4.5 - 11.0 feet BLS.
	W-23	582.63	584.66	6.0 - 26.0	4.0 - 26.0	Gray, clay, massive, plastic to very plastic. Light yellow brown, silty to fine sand, distinct bedding with brown discoloration along bedding planes 4.5 - 6.0 feet BLS. Sandy topsoil.
	W-24	585.07	587.22	6.0 - 26.0	4.0 - 26.0	Gray, clay, occasionally silty, massive, firm to plastic, clays occasionally fat. Light yellow brown silty fine sand intercalated with clay 4.5 - 6.0 feet BLS. Strong septic odor at 6.0 and at 14.5 - 16.0 feet BLS. Scattered gravel at 25.0 feet BLS.
	W-25	584.43	586.56	5.6 - 25.6	4.0 - 25.6	Brownish olive gray, clay, massive, very plastic. Blue green silty fine sand to clean fine sand 4.5 - 10.0 feet BLS. Coarse sand zone of 25.0 feet BLS.

3.3 SITE SPECIFIC INVESTIGATIONS

3.3.1 Site No. 1, Southwest Sanitary Landfill (SSL)

Four groundwater monitoring wells were installed and three surface water locations sampled at this site. The monitoring wells were screened into the upper 20 feet of the unconsolidated formation. Monitoring well W-22 was established on the east perimeter of this site; W-23 on the north, W-24 on the west, and W-25 on the south. The first surface water location selected for water quality sampling is a ponded area in the middle of the landfill. The second surface water location was in a ravine located immediately northwest of the site.

The monitoring wells ranged in depth from 25.0 to 26.0 feet BLS. Groundwater was encountered during drilling from 3.0 feet BLS at W-22 to 6.0 feet BLS at W-24. Silty clays to fat clay predominates in the monitoring wells at this site. However, a fine sandstone was encountered just below the surface in all wells. At monitoring well W-25 a lens of coarse sand was encountered from 23.0 to 25.0 feet BLS. A graphic summary of these wells is presented in Figure 3-3.

An HNu photoionization meter with a 10.2-electron volt ionization lamp was used to monitor air quality and vapors emanating from the drill cuttings during drilling and well construction. Ambient air concentrations did not exceed 2 ppm in the vicinity at SSL. This background level was exceeded at wells W-22 and W-24 during drilling. The water and drill cuttings from these two wells displayed HNu concentrations of 4-6 ppm. A strong septic odor was noted at W-24 from depths of 4.5 to 6.0 feet BLS in the unconsolidated sand. Orange colored leachate stains were observed emanating from a small bermed area adjacent to well W-23. As no fluid was flowing from these seeps, a surface water sample could not be obtained. The location of these wells are shown in Figure 3-2.

3.3.2 Site No. 2, Fire Training Area-2 (FTA-2)

Three groundwater monitoring wells were installed and two surface water locations sampled at this site. The monitoring wells were screened into the upper 20 feet of the saturated zone in the unconsolidated formation. Wells W-19, W-20 and W-21 were established around the perimeter of the burn area; well W-19 to the northwest, well W-20 to the northeast, and well W-21 to the southeast. The surface water locations selected for water quality sampling are located inside the bermed area at the center of the FTA-2

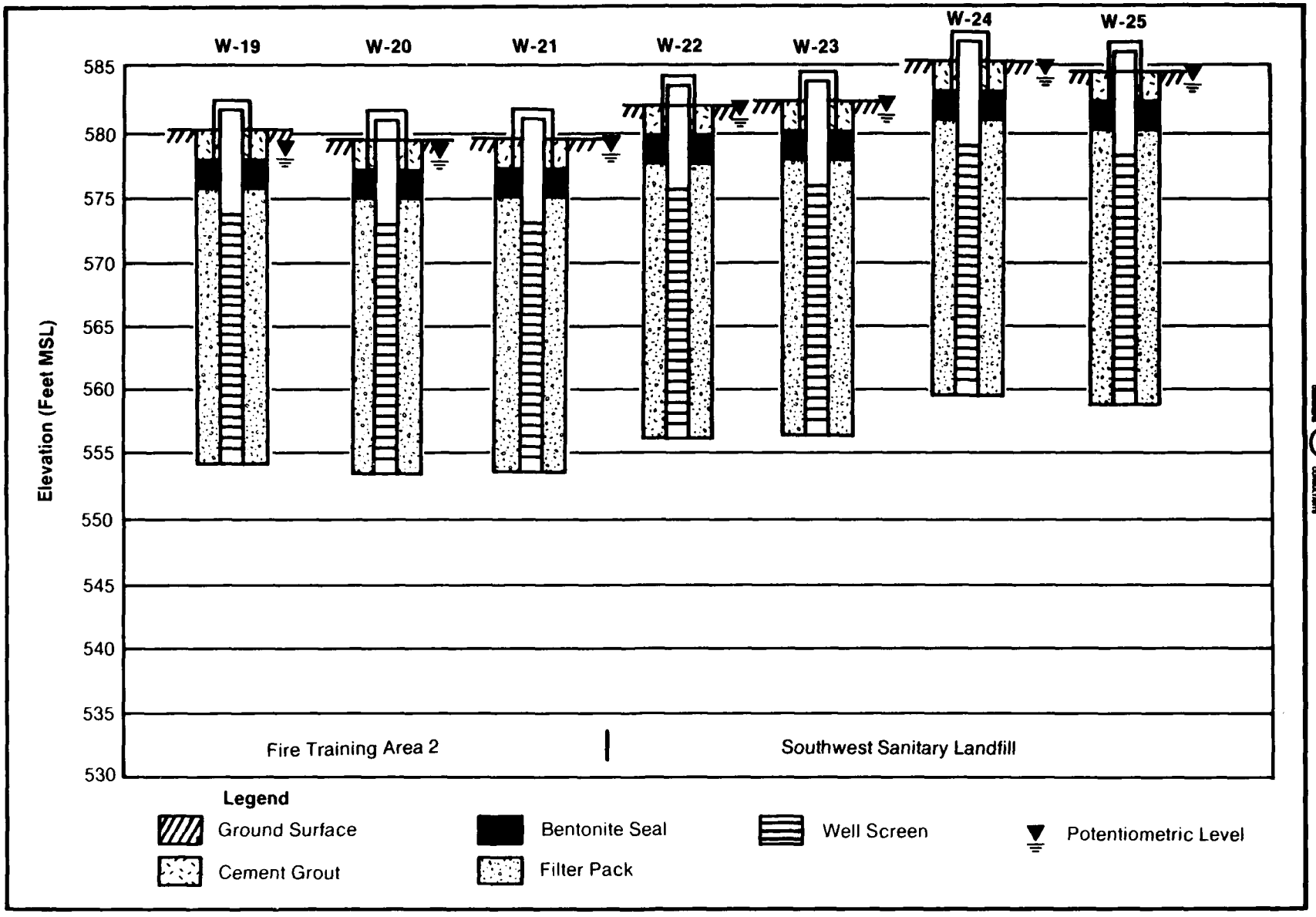


FIGURE 3-3 WELL CONSTRUCTION SUMMARY, FIRE TRAINING AREA 2 AND SOUTHWEST SANITARY LANDFILL

and this bermed area is used to retain fuels ignited during training exercises.

All monitoring wells were drilled to a depth of 26.0 feet BLS. Groundwater was encountered during drilling from 12 feet BLS at wells W-20 and W-21 to 14 feet BLS at well W-19. Silty to fat clay predominates in these borings. A zone of silty fine sand was encountered at well W-19 from 4.5 to 6.0 feet BLS. Petroleum product wetness was observed in the clays of well W-20 from 4.5 to 6.0 feet BLS. Petroleum odor was noted in the clays of well W-21 from surface to 6.0 feet BLS. A graphic summary of these wells is presented in Figure 3-3.

Background photoionization meter readings in the FTA-2 area were 2 ppm. At wells W-20 and W-21 HNu readings of 12 ppm to 70 ppm were observed in the petroleum contaminated soils. All other HNu readings of drill cuttings and groundwater did not exceed the background value. The locations of these wells are shown in Figure 3-2.

3.3.3 Site No. 3, Fire Training Area-1 (FTA-1)

Three groundwater monitoring wells were established at this site. The monitoring wells were screened into the upper 20 feet of the saturated zone of the unconsolidated formation. Monitoring wells W-16 and W-17 were established along the east perimeter of the Fire Training Area-1 adjacent to the north-south trending fence enclosing the compound. Wells W-16 and W-17 are located at a distance of 10.0 feet from the fence; well W-16 at the southeast corner and well W-17 at the northeast corner of the FTA-1. Monitoring well W-18 was established along the west perimeter of the FTA-1 adjacent to the north-south trending fence enclosing the compound. Well W-18 is located at a distance of 10.0 feet from the fence and midway between the northwest and southwest corners of the FTA-1.

Monitoring wells W-16, W-17, and W-18 were drilled to a depth of 26.0 feet BLS. Groundwater was encountered during drilling of these wells at 12.0 feet BLS. Clays of high plasticity predominate in all three wells. No sand lenses were encountered and the topsoil at all three well locations is composed of silty clays. A graphic summary of these wells is presented in Figure 3-4.

Photoionization meter readings of ambient conditions in the vicinity of the FTA-1 were less than 2 ppm. Readings from

length of 2-inch, inside diameter, stainless steel well screen was installed in each boring. This screen was to be

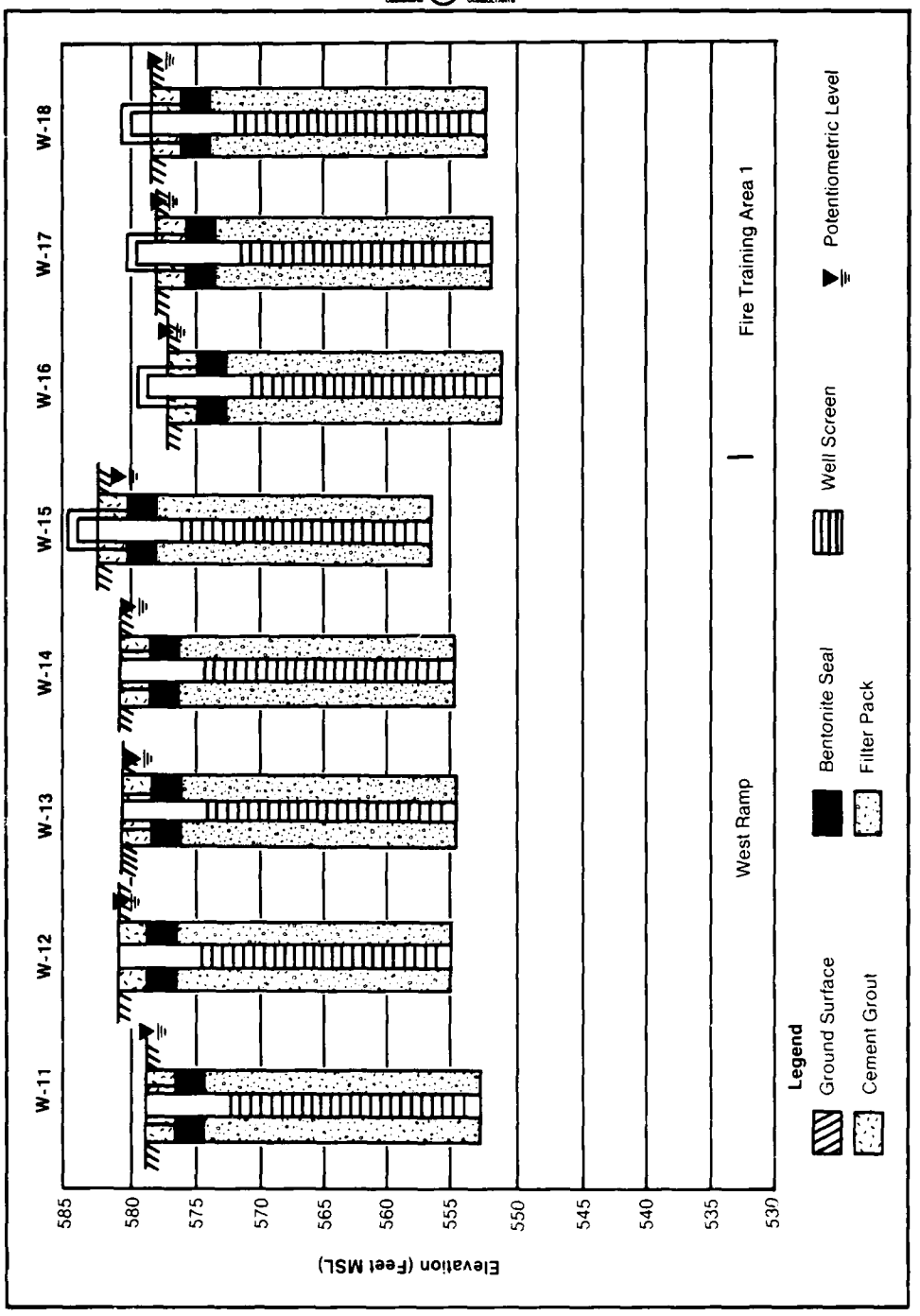


FIGURE 3-4 WELL CONSTRUCTION SUMMARY, WEST RAMP AND FIRE TRAINING AREA 1

well W-17 of 3 to 5 ppm were noted in the drill cuttings from 4.5 to 16.0 feet BLS. An HNu value of 50 ppm was noted in the cuttings from well W-18 at a depth of 9.5 to 11.0 feet BLS. There were no other field indicators of potential contamination at the FTA-1. The locations of these wells are shown in Figure 3-2.

3.3.4 Site No. 4, West Ramp (WR)

Five groundwater monitoring wells, ranging in depth from 25.5 to 26.0 feet BLS, were installed at this location and screened into the upper 20 feet of the unconsolidated formation. The locations of monitoring wells W-11, W-12, W-13, W-14, and W-15 are shown in Figure 3-2. Well W-11 is situated in a small swale that readily ponds water during wet periods. Well W-11 as well as wells W-12, W-13, and W-14 lie off of the West Ramp by 20 feet and have a flush mounted protective casing. Well W-15 is situated in a grassy area south of well W-11 along the west side of the West Ramp and has a protective casing protruding 2.0 feet above ground surface.

Silty clay predominates in the wells at this site. A silty to clayey-silty sand noted as fill, occurs from the surface to approximately 5.0 feet BLS and is common to the wells at this site. Another fine sand body occurs from approximately 23.0 to 25.0 feet BLS in wells W-11, W-12, W-13, and W-14. Groundwater was encountered during drilling at approximately 12 to 15 feet BLS. A graphic summary of these wells is presented in Figure 3-4.

Photoionization meter readings of 50 to 300 ppm were observed in the topmost soils at wells W-11 and W-15. A strong petroleum odor was also noted emanating from the soils at these two locations. The source of this petroleum contamination is probably related to the January 1984 fuel spill.

Soil samples were collected during drilling from all five wells for laboratory analysis. Representative geological samples were collected at 2.5 foot intervals for the first 10 feet and at 5 foot intervals to a total depth. Three samples from each well were submitted for analysis, the remaining samples were retained for possible future analysis.

3.3.5 Site No. 5, Tucker Creek Landfill (TCL)

Three groundwater monitoring wells were installed at the Tucker Creek Landfill site and screened into the upper 20 feet of the saturated zone in the unconsolidated formation at depths ranging from 25.0 to 26.0 feet BLS. The locations of these wells are shown in Figure 3-2. Wells W-6 and W-7 were established along the east perimeter of the landfill site and adjacent to the marina and boat basin. Well W-5 was established at the southwest perimeter of the landfill west of Jefferson Avenue.

Clays of high plasticity predominated in the well borings. Lenses of sand were encountered at 21.0 feet BLS at well W-6 and 25.0 feet BLS at W-7. Topsoil/fill at all three locations ranged from silty clayey sand at well W-5 to sandy gravel and concrete rubble at wells W-6 and W-7. Groundwater was encountered during drilling between 11.0 and 14.5 feet BLS in all three wells. A graphic summary of these wells is presented in Figure 3-5.

There were no anomalous photoionization meter readings or other field indicators of potential contamination at these drilling locations.

3.3.6 Site No. 6, Northwest Landfill (NL)

Three groundwater monitoring wells were installed at the Northwest Landfill and screened into the upper 20 feet of the unconsolidated formation to a depth of 26.0 feet BLS. The locations of monitoring wells W-8, W-9, and W-10 are shown on Figure 3-2. Wells W-8 and W-9 were established in a grassy area adjacent to the road skirting the east perimeter of the landfill. Well W-10 was established midway between the road leading to Building 1400 and a drainage ditch on the west perimeter of the landfill.

Clays of high plasticity predominated in the well borings. The surficial soils at all three well locations consisted of sand fill and clay. Gravelly silty sands were encountered in well W-10 from 23.5 to 25.0 feet BLS. Groundwater was encountered between 5.0 and 6.0 feet BLS in well W-8, 1.0 to 2.0 feet BLS in well W-9 and 12 feet BLS at well W-10. A graphic summary of these wells is presented in Figure 3-5.

There were no anomalous photoionization meter readings or other field indicators of potential contamination at these drilling locations.

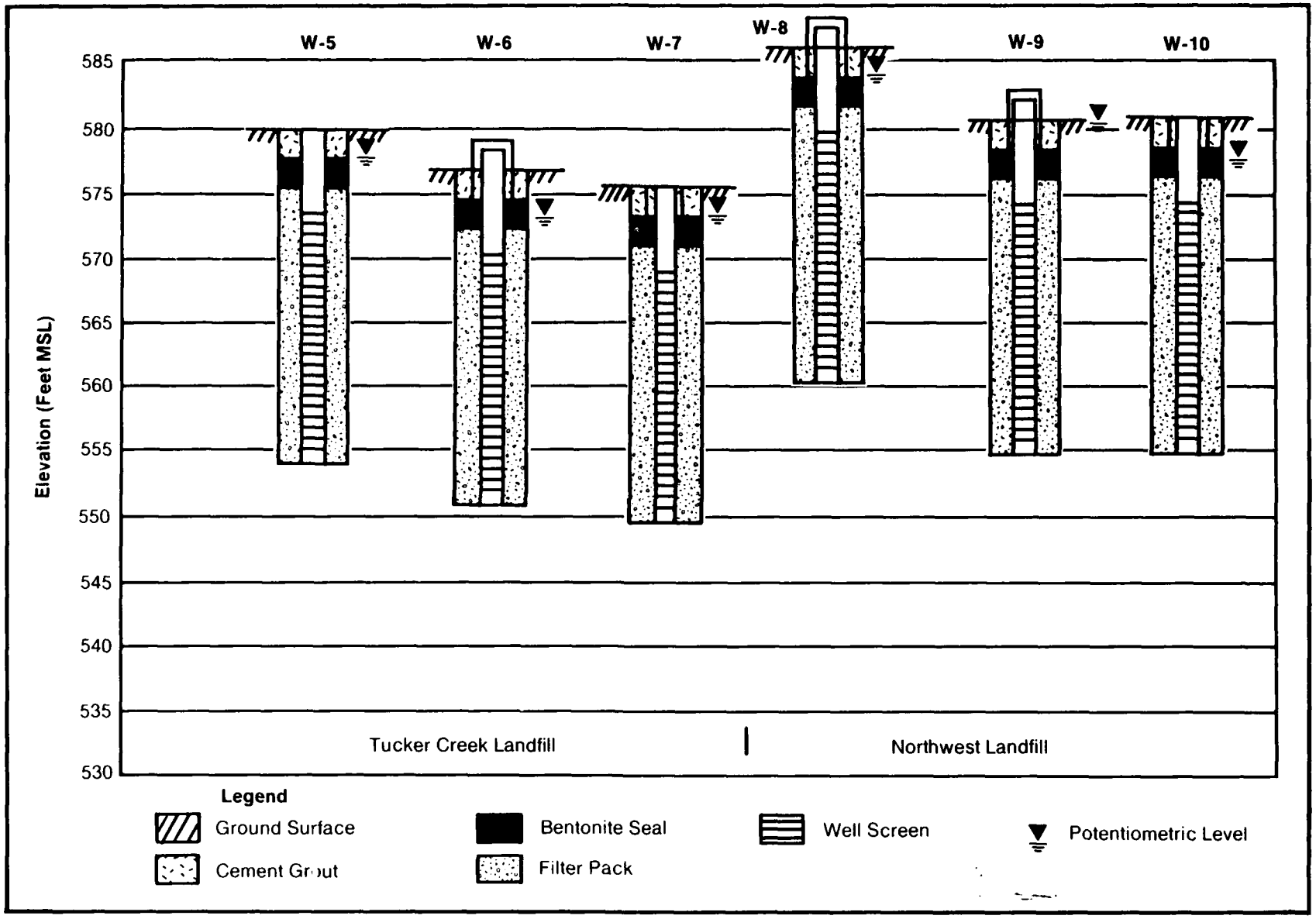


FIGURE 3-5 WELL CONSTRUCTION SUMMARY, TUCKER CREEK LANDFILL AND NORTHWEST LANDFILL

3.3.7 Site No. 7, East Ramp (ER)

Four groundwater monitoring wells were installed at the East Ramp Fuel Spill area and screened into the upper 20 feet of the unconsolidated formation ranging in depth from 25.5 to 26.0 feet BLS. The locations of wells W-1, W-2, W-3, and W-4 are shown in Figure 3-2. Wells W-1 and W-2 were established in the grassy area adjacent to the south edge of the ramp at a distance of approximately 15.0 feet. Well W-3 was located to the northeast of the ramp just east of the liquid oxygen (LOX) tanks. Well W-4 was established on a grassy island north of hangar No. 4 at the northeast corner of the ramp.

Clays of high plasticity were common to all well borings. The surficial soil at all four locations was comprised of silty sand fill. A gravelly sand zone was observed in well W-4 at 23.5 to 25.0 feet BLS. Groundwater was encountered during drilling at approximately 12.0 feet BLS in all wells at this site. A graphic summary of these wells is presented in Figure 3-6.

Photoionization meter readings ranging from 2 ppm (background BG) to 8 ppm were detected in the drill cuttings of all four wells. In wells W-1, W-2 and W-4 these readings were recorded in the upper 10 feet of the borings. HNu readings of 3 to 8 ppm were detected in the drill cuttings from well W-3 to a depth of 20.0 feet BLS. These anomalous HNu readings were the only field indicators of potential contamination at the East Ramp area.

Soil samples were collected during drilling from all four wells for laboratory analysis. Representative geological samples were collected at 2.5 foot intervals for the first 10 feet and at 5 foot intervals to total depth. Three samples from each well were submitted for analysis, the remaining samples were retained for possible future analysis.

3.4 SAMPLING

The purpose of the water quality sampling program was to identify, insofar as possible at the level of a confirmation survey, the location, concentration and areal extent of any contamination present in the hydrogeologic environment. To achieve these goals efficiently, specific field procedures were followed for purging the wells, collecting the samples, and ensuring the field quality control. The sampling and quality assurance plans used to accomplish these goals are contained in Appendix E. Sample chain-of-custody documentation is contained in Appendix F. Standard laboratory

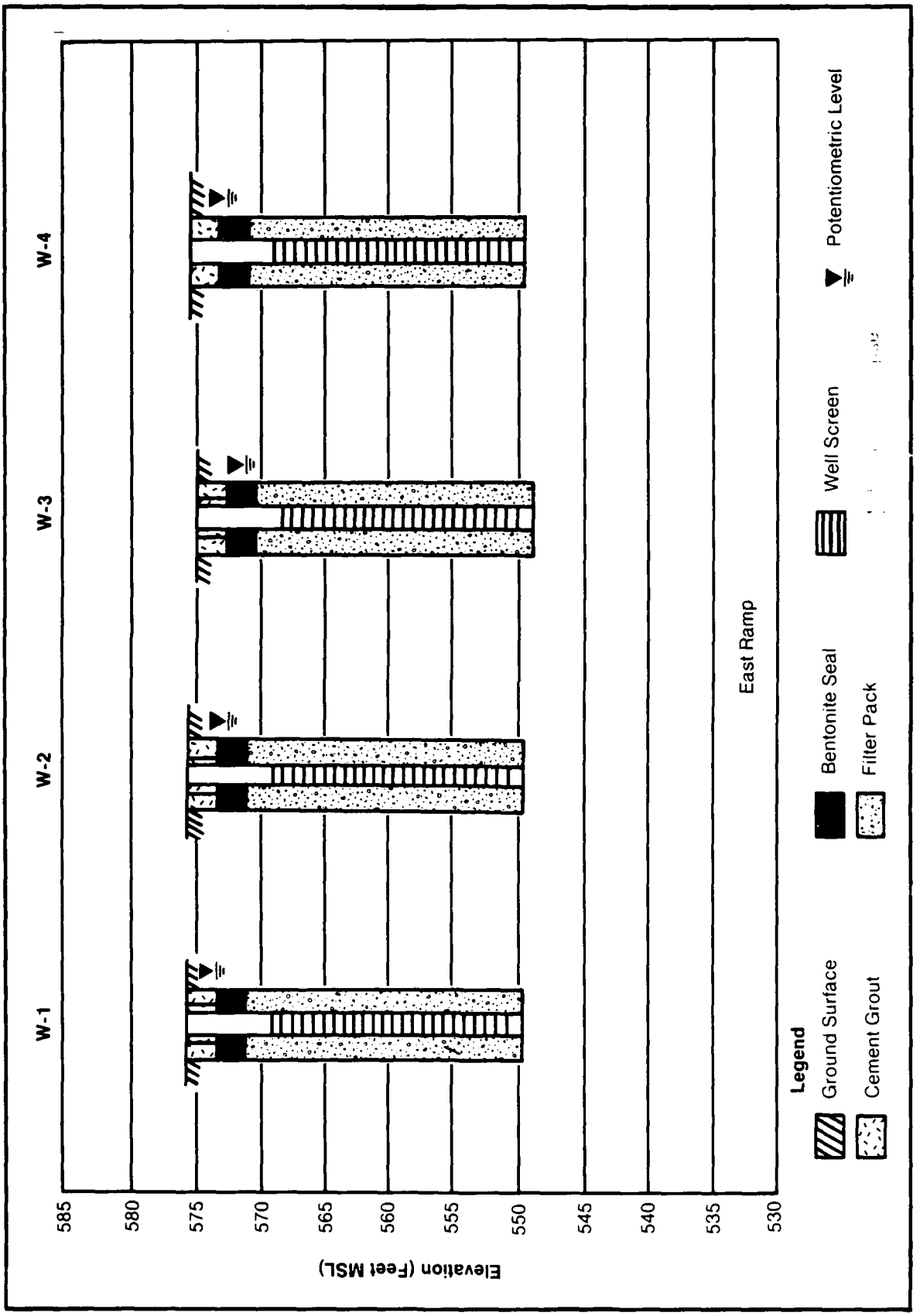


FIGURE 3-6 WELL CONSTRUCTION SUMMARY, EAST RAMP

analysis protocols used in the analysis of these samples are contained in Appendix G.

One round of groundwater and soil sampling was conducted at Selfridge ANGB. The soil samples collected at the West and East Ramp sites were obtained during well construction, 21 January to 2 February, 1985. One round of ground and surface water sampling was accomplished in three episodes. Environmental sampling at wells W-3 through W-25 and required surface water locations was accomplished 5-11 March 1985. Due to snow cover at the Base during the initial sampling episode, wells W-1 and W-2 were not accessible and were sampled 17-18 April 1985. The holding times for the Volatile Organics Analysis (VOA) parameters were exceeded by eight days for all ground and surface water samples collected 5-11 March 1985. A resample round for the VOA parameters was conducted 10-11 May 1985. Ponds A and B and ponds 1, 2 and 3 could not be sampled because they were dry during the resampling period. Therefore, the data discussed in Section 4 for these sampling points are the results from the March sampling. Samples from each well and surface water location were packaged and preserved according to the analyses required at each location (See Table 1-3).

3.5 WATER LEVEL MEASUREMENTS

Three complete rounds of water level elevation measurements were conducted. The first round was completed during the initial environmental sampling episode 5-11 March 1985. The second round was accomplished on 17 April 1985 during the sampling of wells W-1 and W-2. The third round was completed 11-12 June 1985. All water level readings were referenced to the top of the well casing using a Soil Test Model DR 706A water level probe. The depths to groundwater and corresponding water level elevations are presented in Table 3-4 and represent the static water level of the saturated zone.

3.6 LOCATION AND ELEVATION SURVEY

A survey was conducted by Technical Engineers and Consultants, Inc., (licensed in Michigan), during June 1985 to determine the elevations of the tops of the well casings, protective casings, and elevations of the surrounding ground surface. These elevations were surveyed to a vertical accuracy ±0.1 foot relative to the United States Geological Survey (USGS) datum. The elevations of the ground surface and tops of the well casings are presented in the well completion summary in Appendix D and in Table 3-5.

Table 3-4

Summary of Groundwater Level Elevation Surveys
Selfridge ANGB

Date-Specific Water Level Elevation

Well No.	Measuring Point	Elev. at Measuring Point (ft)	3/7-8/85 DTW (ft)	3/7-8/85 WLE (FMSL)	4/17/85 DTW (ft)	4/17/85 WLE (FMSL)	6/11/85 DTW (ft)	6/11/85 WLE (FMSL)
W-1	2" PVC	575.82			2.64	573.18	5.11	570.71
W-2	2" PVC	575.36			2.86	572.25	4.58	570.78
W-3	2" PVC	574.34	1.50	572.84	3.28	571.06	3.57	570.77
W-4	2" PVC	575.67	2.60	573.07	3.30	572.04	3.65	571.69
W-5	2" PVC	578.91	0.0	578.91	1.04	577.87	0.93	577.98
W-6	2" PVC	579.06	7.57	571.49	6.02	573.04	6.46	572.60
W-7	2" PVC	576.36	2.27	574.09	3.04	573.32	3.44	572.92
W-8	2" PVC	589.09	2.93	586.16	5.28	583.81	7.52	581.57
W-9	2" PVC	583.66	1.22	582.44	1.85	581.81	4.44	579.22
W-10	2" PVC	580.67	2.35	578.32	3.29	577.38	2.25	578.42
W-11	2" PVC	578.45	0.0	578.45	0.36	578.09	0.0	578.45
W-12	2" PVC	581.69	0.73	580.96	1.15	580.54	2.49	579.20
W-13	2" PVC	581.07	3.04	578.03	2.84	578.23	2.85	578.22
W-14	2" PVC	581.43	1.67	579.76	1.60	579.83	2.82	578.61
W-15	2" PVC	584.75	3.89	580.86			5.20	579.55
W-16	2" PVC	579.61	2.12	577.49	2.19	577.42	5.63	573.98
W-17	2" PVC	579.96	2.36	577.60	2.46	577.50	5.78	574.18
W-18	2" PVC	580.27	2.28	577.99	2.57	577.70	4.67	575.60
W-19	2" PVC	582.37	3.46	578.91	3.78	578.59	7.17	575.20
W-20	2" PVC	581.32	4.78	576.54	4.41	576.91	Destroyed	
W-21	2" PVC	581.46	2.47	578.99	2.78	578.68	6.78	574.68
W-22	2" PVC	584.63	2.76	581.87	3.15	581.48	7.11	577.52
W-23	2" PVC	584.66	2.22	582.44	3.17	580.95	7.27	577.39
W-24	2" PVC	587.22	3.49	583.73	2.97	584.25	5.00	582.22
W-25	2" PVC	586.48	3.70	582.78	3.86	582.62	6.68	579.80

DTW = Depth to Water
WLE = Water Level Elevation
FMSL = Feet above Mean Sea Level

Table 3-5
Summary of Elevations of Monitoring Wells
Selfridge ANGB

Well Numbers	Ground Elevation (ft msl)	Top of PVC Casing (ft msl)	Top of Steel Casing (ft msl)
W-1	576.50	575.82	576.08
W-2	576.34	575.36	575.83
W-3	575.01	574.34	574.50
W-4	575.87	575.67	575.79
W-5	579.85	578.91	579.03
W-6	577.24	579.06	579.14
W-7	576.51	576.36	576.41
W-8	587.14	589.09	589.19
W-9	581.01	583.66	583.75
W-10	581.76	580.67	581.25
W-11	578.83	578.45	578.65
W-12	582.15	581.69	581.85
W-13	581.66	581.07	581.27
W-14	581.94	581.43	581.59
W-15	582.79	584.75	584.86
W-16	577.47	579.61	579.73
W-17	577.87	579.96	580.05
W-18	578.15	580.27	580.41
W-19	580.40	582.37	582.37
W-20	579.37	Destroyed	581.32
W-21	579.55	581.46	581.52
W-22	582.60	584.63	584.60
W-23	582.63	584.66	584.69
W-24	585.07	587.22	587.32
W-25	584.43	586.48	586.56

At the time the survey was performed in June 1985, the state grid system had not been established in the Mt. Clemens area. Consequently, the USAF Geodetic Services Division had not finialized the Base grid system. It is not known when these systems will be established. Therefore the locations of the monitor wells were referenced to local quarter section markers. When the Base grid system is finally established the monitor well coordinates can be readily interpreted from the existing data.

SECTION 4

RESULTS

4.1 SITE GEOLOGY

Analysis of the geologic information compiled during the Phase I Records Search and obtained from Michigan state publications and the subsurface data collected during the Phase II field program reveals that Selfridge ANGB is underlain by unconsolidated materials of glacial, lacustrine and fluvial origin. These materials unconformably overlie an eroded Devonian bedrock surface with an approximate maximum relief of 75 feet in the vicinity of Selfridge ANGB. The thickness of the unconsolidated overburden is estimated from prior investigations to vary between 70 and 150 feet.

The unconsolidated overburden in the vicinity of the Selfridge ANGB consist of the following mappable units:

- Gray to dark brown plastic clays of lacustrine origin with minor fine sand and silt. This unit was deposited by low energy sedimentation in ancestral Lake St. Clair. This is the predominant surficial unit on the Base and is estimated from previous studies to be a maximum of 35-50 feet thick.

- Buff to light brown sand and small gravel with minor silt and clay-sized fraction. This unit represents the moderate to high energy sedimentary environments along the shoreline of ancestral Lake St. Clair. Two distinct shoreline deposit units are present in the Mount Clemens area. The first occurs approximately one and one half miles west of the Base along the present route of Gratiot Avenue. The second occurs in the western portion of the Base along the former route of Sugarbush Road. Because of the coarse grained nature of this unit it has been used extensively as a borrow source for fill material at the Base and is no longer present in its original morphology. It is estimated that the thickness of this unit was less than 15 feet prior to the initiation of re-grading activities at the Base.

- Gray to brown moderately to poorly sorted clays, silts, sands and gravels. This alluvial unit was deposited along the southern portion of the Base

by the sediment transport mechanisms associated with the Clinton River. A similar belt of alluvial deposits is postulated to occur along the former course of the Tucker Creek; however, this cannot be substantiated by existing subsurface information.

- Moderately to poorly sorted clays, silts, sands and gravels of glacial origin. This unit outcrops west of the Gratiot Avenue shoreline and occurs at a depth of approximately 20-30 feet below the land surface in the vicinity of the Base. The existing well logs in the Macomb County area suggest that the glacial deposits become coarser with depth. The aforementioned units are all the result of re-working of this glacial drift unit.

Hydrogeologic cross-sections depicting the subsurface distribution of these materials are presented in Figures 4-1 and 4-2. The trace for these cross-sections are shown in Figure 4-3.

4.2 SITE GROUNDWATER CONDITIONS

The unconsolidated overburden is the only significant source of potable groundwater in the Macomb County area. Yields from wells completed in the overburden are reported to be less than 10 gallons per minute (gpm). Sand and gravel lenses found at depths greater than 25 feet yield adequate water supplies for domestic purposes. These sand and gravel lenses occur under confined or artesian pressures. An analysis of existing well records suggests that the artesian pressure increases approximately 0.8 of a foot per foot of depth.

The groundwater in the bedrock is known to be highly mineralized, and is generally unsuitable for domestic, industrial or irrigation purposes. It is reported that the lower portion of the glacial drift (below 50 to 70 feet) is highly mineralized (USGS, 1975) thereby suggesting upward groundwater movement into the drift from the bedrock.

During the installation of the Phase II monitoring wells, saturated materials were generally encountered at a depth of 8 to 14 feet below land surface. The static groundwater levels in these wells stabilized within 5 feet of the land surface. Variations in these levels are attributable to local topographic relief, the type of material at a given location and the proximity of subsurface drains and

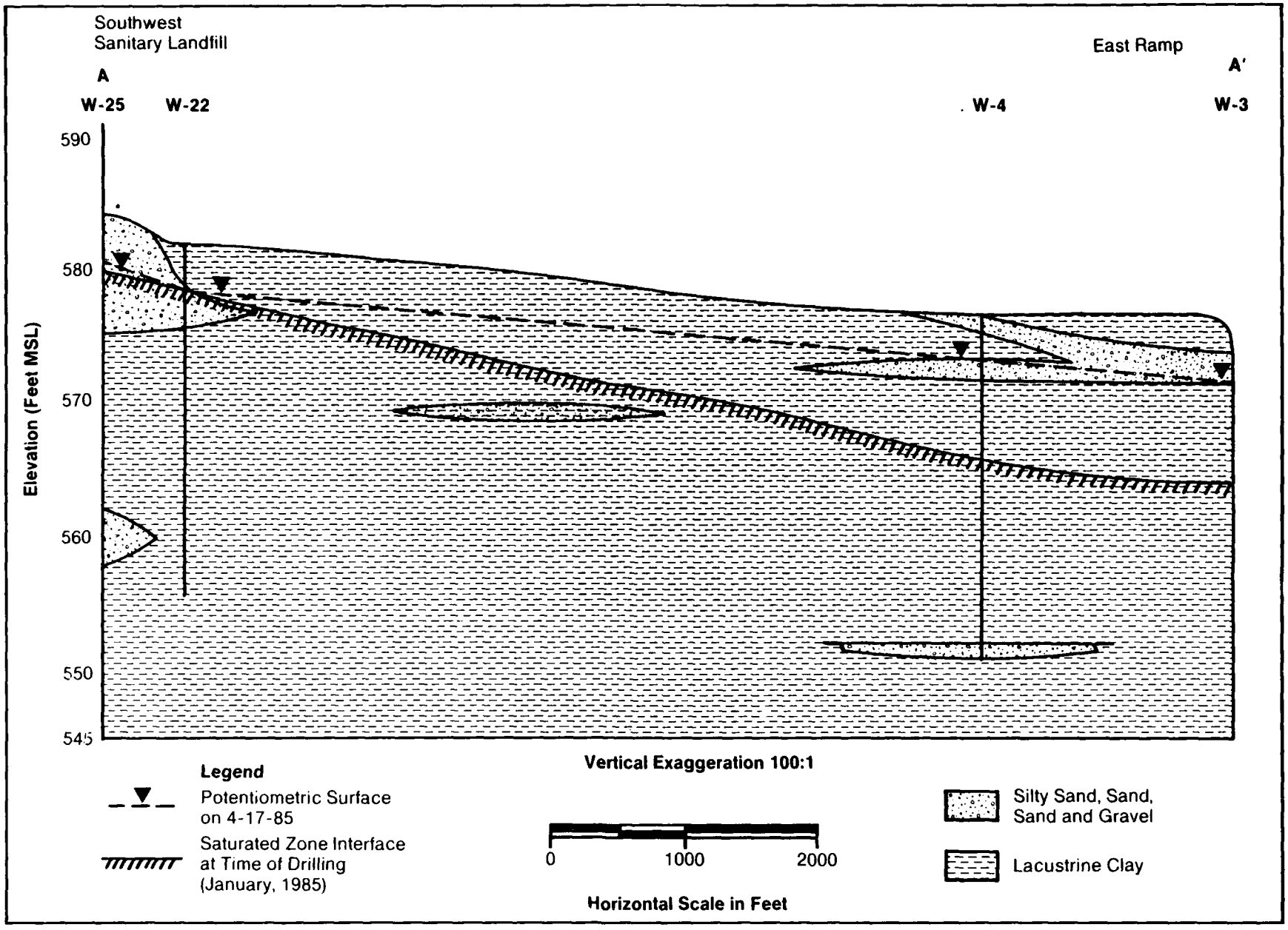


FIGURE 4-1 HYDROGEOLOGIC CROSS SECTION A-A'

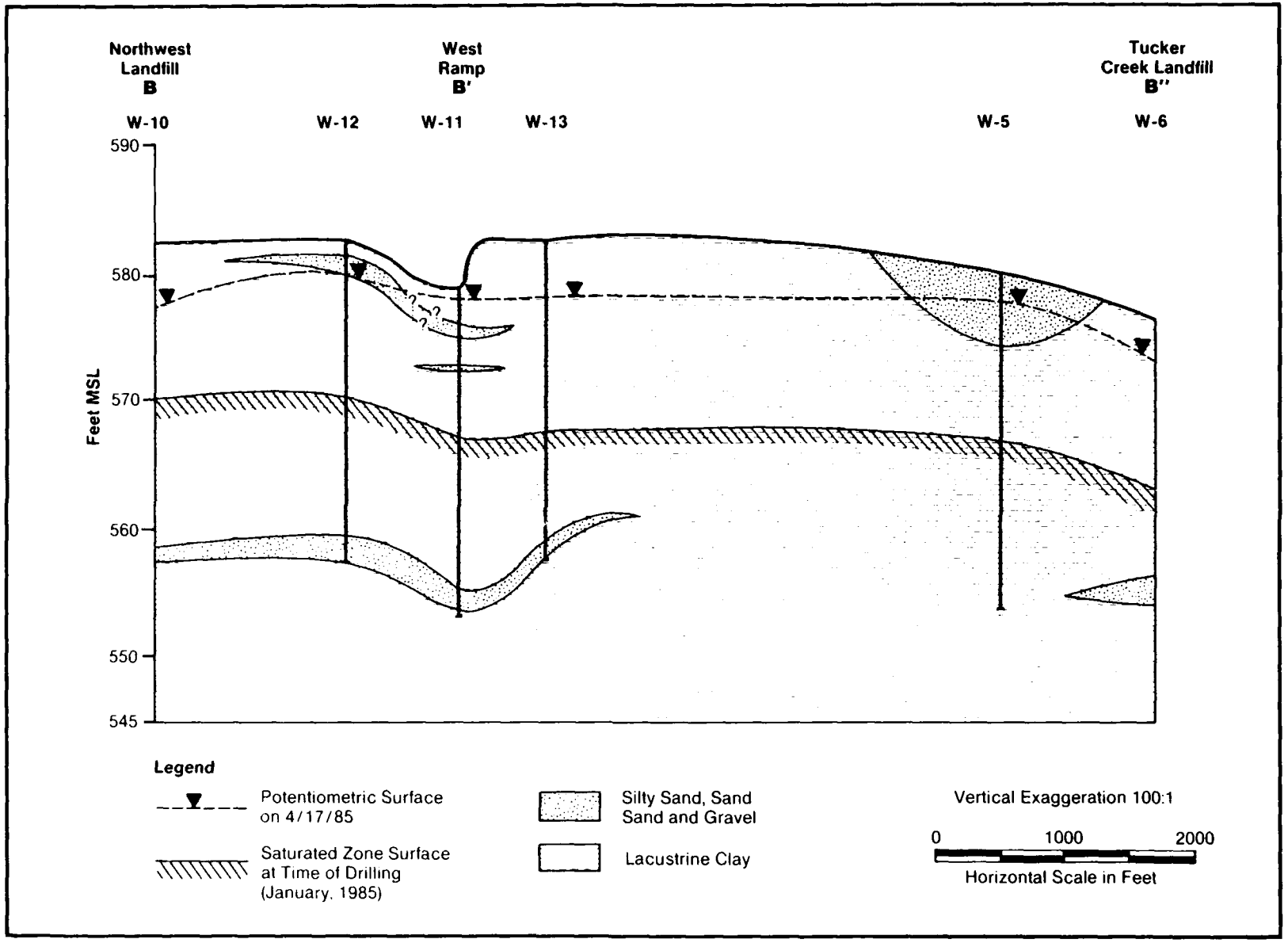
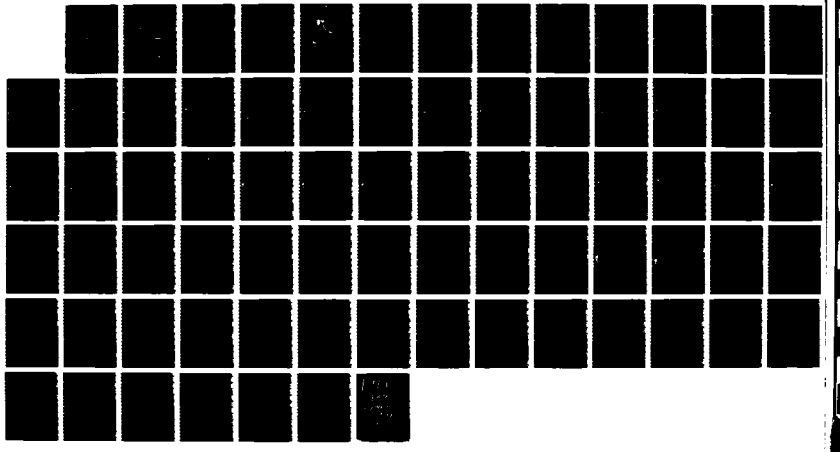
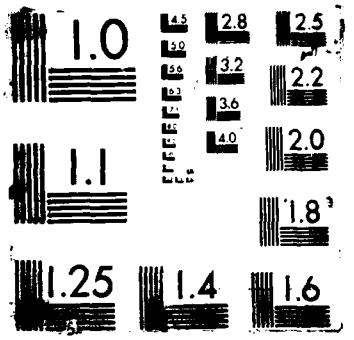


FIGURE 4-2 HYDROGEOLOGIC CROSS SECTION B-B'-B''

AD-A195 612 INSTALLATION RESTORATION PROGRAM PHASE 2 2/2
CONFIRMATION/QUANTIFICATION STAGE 1 VOLUME 1(U) WESTON
(ROY F) INC WEST CHESTER PA J E DOWDEN ET AL.
UNCLASSIFIED 10 OCT 86 F33615-80-D-4006 F/G 24/3 NL




1.0
1.1
1.25
1.4
1.6
1.8
2.0
2.2
2.5
2.8
3.2
3.6
4.0
4.5
5.0

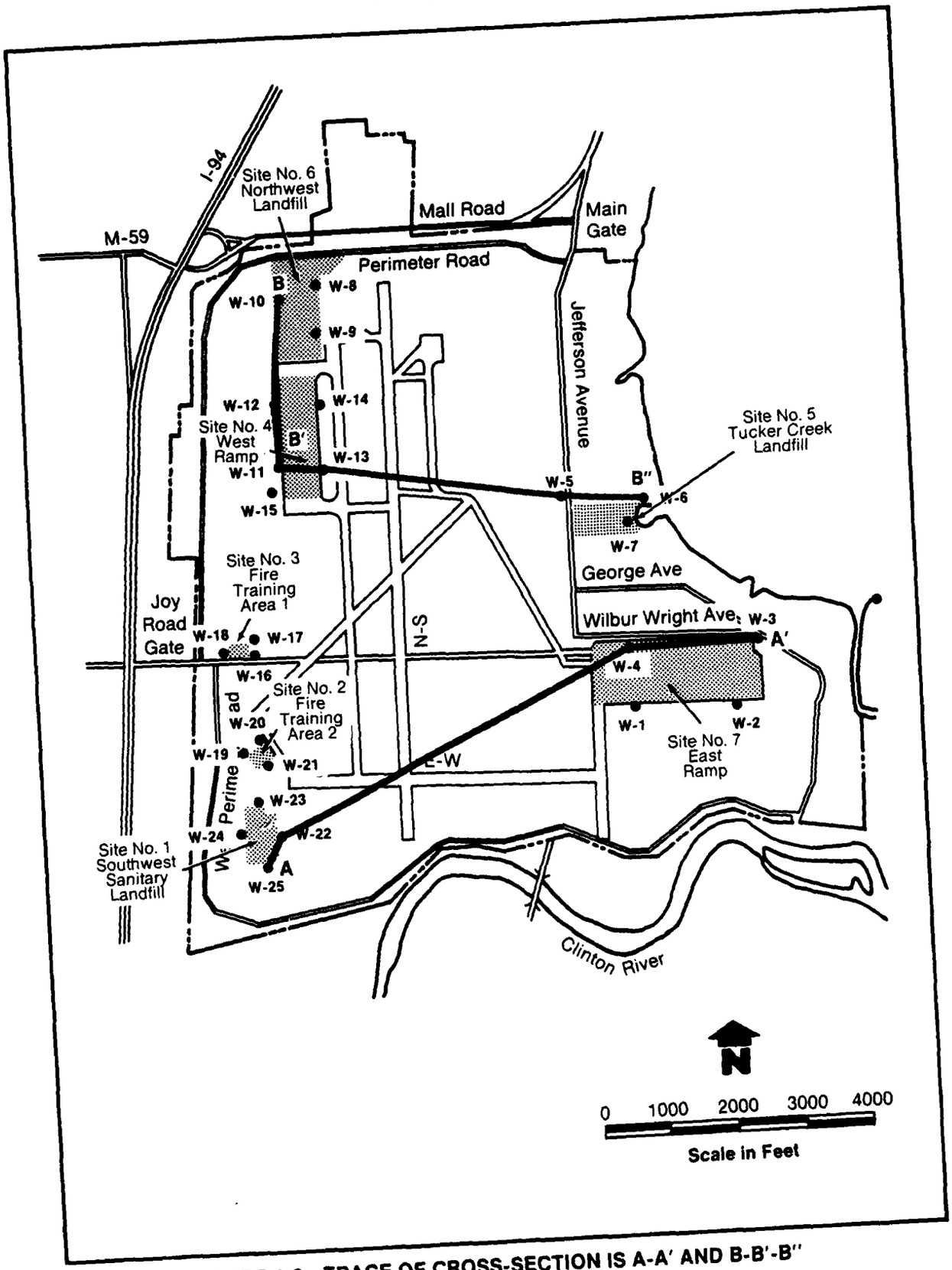


FIGURE 4-3 TRACE OF CROSS-SECTION IS A-A′ AND B-B′-B″

backfilled excavations. The magnitude of seasonal groundwater level fluctuations is on the order of 2 to 5 feet. These fluctuations are depicted graphically on Figure 4-4.

The shallowest potentially usable aquifer(s) beneath the Base occur at various depths below 20 feet BLS. These zones are probably of small vertical and areal extent but generally yield enough water for domestic supplies. The greatest concentration and extent of these lenses occurs in the northwest corner of the Base where several of the borings reported sandy intervals at depths ranging from 20 to 35 feet BLS.

A second potential shallow aquifer is indicated by the sand deposits encounterd in the geotechnical borings in the southwest corner of the Base within the alluvial deposits, which are generally confined to the upper 10 feet of the soil profiles of the Clinton River. These sand bar deposits probably extend across the southern portion of the Base.

Infiltration of direct precipitation is the primary source of recharge to the shallow aquifers in the unconsolidated overburden. Upward flow of groundwater from the underlying bedrock is probably a significant source of recharge to the water bearing zones in the lower portions of the overburden. The extent of interaction between the shallow and deep water bearing zones within the overburden is unknown.

An analysis of the regional topography suggests that groundwater in the unconsolidated overburden in Macomb County flows eastward and probably discharges to Lake St. Clair. This is supported by the configuration of the potentiometric surface which is presented in Figure 4-5. Local variations in the direction of groundwater flow can be attributed to contrasts in permeabilities, the proximity of topographic depressions, and surface water bodies which can be sources of recharge or receptors of groundwater discharge.

Only one groundwater well is still functional at the Base. This well is located on the extreme southern edge of the Base near Building 1695. This well is reported to be completed at a depth of 52 feet and is probably screened in sand and gravel lenses in the glacial drift. The well is currently capped and protected by a small shed. A second well, which is no longer in service, is located behind Building 1537 in the southwest corner of the Base. The log from this well indicates that it is completed in gravel in the interval 53-59 feet BLS.

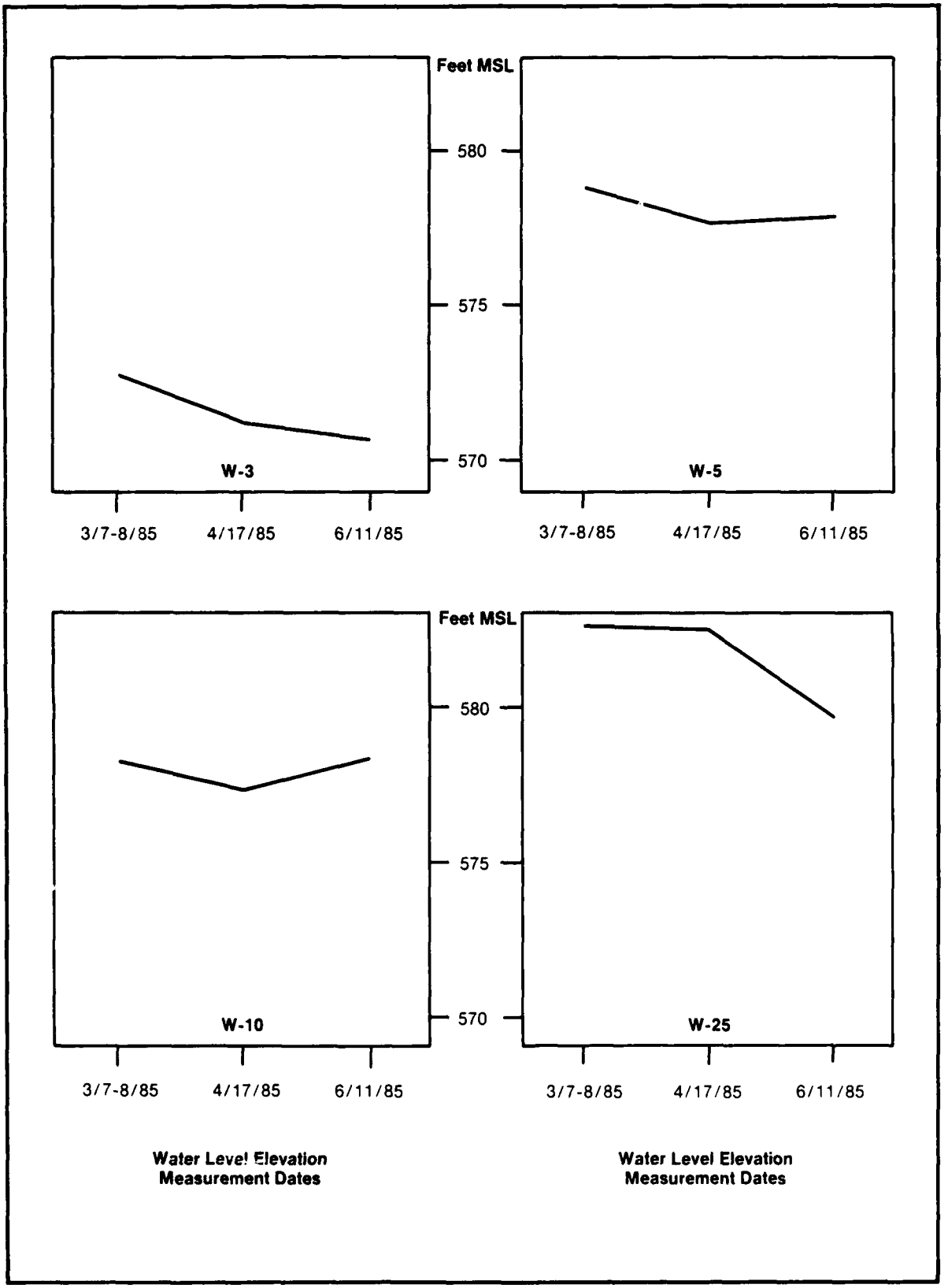


FIGURE 4-4 HYDROGRAPHS OF MONITORING WELLS W-3, W-5, W-10, AND W-25

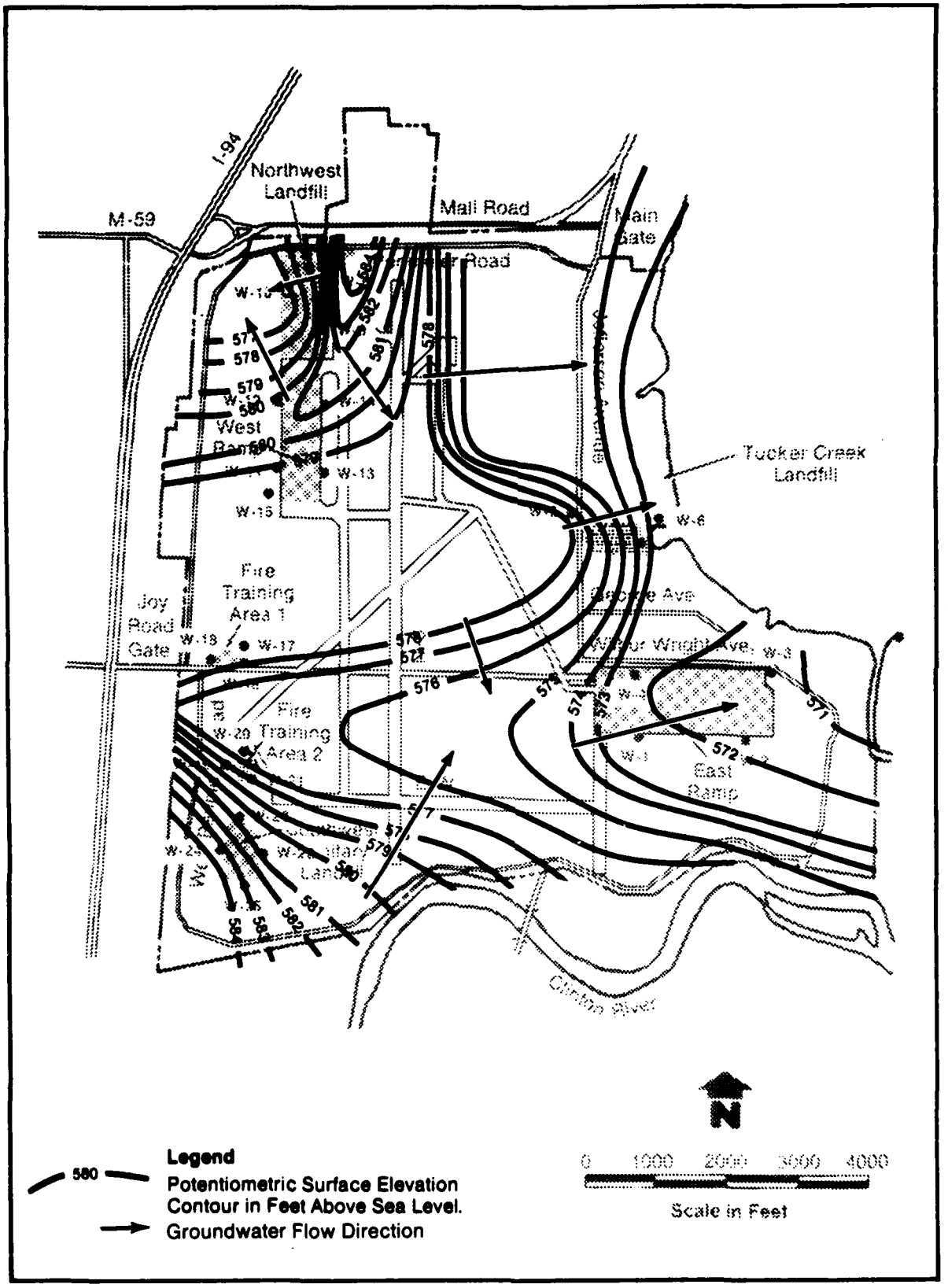


FIGURE 4-5 POTENTIOMETRIC SURFACE AT SELFRIDGE ANGB (17 APRIL 1985)

The permeability of the lacustrine and alluvial deposits which underlie the Base is generally considered to be low to very low. Consequently, the corresponding groundwater flow and contaminant migration velocity are anticipated to be small. The notable exceptions to this generalization are in the northwest and southern portions of the Base, where coarser grained and higher permeability deposits are known to exist.

A description of the groundwater conditions at each of the Phase II investigation sites is provided in the following sections.

4.2.1 Groundwater Flow, Site No. 1, Southwest Sanitary Landfill

Groundwater beneath the Southwest Sanitary Landfill occurs under water table and/or semi-confined conditions within the alluvial sands and silt deposits of the Clinton River meander belt. Saturated soils were encountered within five feet of the land surface in the wells around the northern, eastern and southern perimeter of the landfill, and at 10 feet BLS in the western monitoring well. Water level measurements from these wells indicate that the hydraulic gradient in the southwest corner of the Base is to the northeast at approximately 0.0048 feet per feet. This suggests that the Clinton River is a source of recharge to the shallow aquifer beneath the southern portion of the Base. The hydraulic gradient is steeper north of the Southwest landfill indicating that the permeability of the shallow unconsolidated formation decreases northward from the Clinton River meander belt.

4.2.2 Groundwater Flow, Site No. 2, Fire Training Area-2

Saturated materials occur at a depth of 12 to 15 feet BLS beneath Fire Training Area-2, within thin silty sand lenses which are interbedded lacustrine silts and clays. Static water levels are generally within 2.5 to 7.5 feet of the land surface, indicating confined conditions. The hydraulic gradient in the vicinity of this site is consistent with that of the Southwest Sanitary Landfill at approximately 0.006 feet per feet toward the northeast. Northeast of the Fire Training Area-2, the hydraulic gradient flattens and changes orientation to the east. This can be attributed to materials of higher permeability, reduced recharge and/or a sparsity of data points.

4.2.3 Groundwater Flow, Site No. 3, Fire Training Area-1

Groundwater beneath Fire Training Area-1 occurs under confined conditions within the lacustrine silts and clays at depths greater than 10 to 12 feet BLS. The hydraulic gradient is approximately 0.004 feet per feet to the southeast in the vicinity of this site. The hydraulic gradient flattens north and southeast of this site. However, because of the sparsity of nearby data points, the significance or cause of this variation cannot be addressed. During the development and sample purging of the monitoring wells at this site, the recharge to these wells was very slow. This is consistent with the fine grained nature of the underlying subsurface materials.

4.2.4 Groundwater Flow, Site No. 4, West Ramp

Saturated materials were encountered at a depth of 6 to 14 feet BLS within the lacustrine silts and clays. However, an area of silty fine sand encountered at a depth of 20 feet BLS provides the major source of water in these wells. The depth to static water level varies between 0.5 and 3.0 feet BLS. As shown on Figure 4-3, the hydraulic gradient is very flat (approximately 0.0008 feet per foot) and oriented towards the south-southeast across the West Ramp. The relatively flat hydraulic gradient in the vicinity of the West Ramp may be at least partially attributable to the lack of recharge to the shallow unconsolidated formation. This, in turn, is due to the extensive covered and paved surfaces, and the effectiveness of the associated drainage system.

4.2.5 Groundwater Flow, Site No. 5, Tucker Creek Landfill

Groundwater occurs within the lacustrine silts and clays underlying the Tucker Creek Landfill at a depth of 12 to 14 feet. The static water levels occur within 1 to 4 feet of the land surface. The hydraulic gradient is eastward at approximately 0.0044 feet per foot across the site. The relative steepness of the hydraulic gradient near this site suggests either the presence of a source of recharge west of the landfill and/or a belt of low permeability material near the shorelines of Lake St. Clair.

4.2.6 Groundwater Flow, Site No. 6, Northwest Landfill

A water table aquifer occurs within 2 to 5 feet of the land surface in the surficial sand deposits along the eastern portion of the Northwest landfill. These sands are associated with the historic Lake St. Clair shoreline, which coincides with the former route of Sugar Bush Road (refer to Section 2.3). South of the landfill, the shoreline sands

have been removed and used as fill material. The thickness of this water table aquifer is expected to average 3 to 5 feet, with a probable seasonal fluctuation of 1 to 2 feet. The aquifer, which is perched on lacustrine silts and clays, is absent in the western portion of the landfill. Saturated conditions within the lacustrine silts and clays occur at a depth of 12 to 14 feet BLS.

The potentiometric surface mound shown in the vicinity of the Northwest Landfill on Figure 4-3 can be attributed to the perched water table. In actuality, the hydraulic head of two distinct groundwater layers are combined and depicted on this figure. Therefore, although the hydraulic gradient in the shallow, saturated lacustrine deposits may be to the northwest, the gradient value of approximately 0.0076 feet per feet is not representative of the actual conditions. It is suspected that the groundwater in both the perched water table system and the shallow lacustrine deposits flows northward and discharges to the Tucker-Jones ditch that bounds the northern perimeter of the Base. The degree of hydraulic interconnection between these two water-bearing units is unknown.

4.2.7 Groundwater Flow, Site No. 7, East Ramp

Groundwater occurs at a depth of 12 to 14 feet BLS beneath the East Ramp, within the lacustrine silts and clays. The static water levels vary between 1.5 and 5.0 feet BLS. The hydraulic gradient is to the northeast at approximately 0.0010 feet per feet. As with the West Ramp, the relatively flat configuration of the potentiometric surface in the vicinity of the East Ramp may be attributable to the reduced infiltration and recharge in this area.

4.3 RESULTS OF WATER QUALITY ANALYSIS

The results of the water quality analyses are summarized in Tables 4-1 through 4-14. The field and laboratory QA/QC results, including field and laboratory blanks, duplicates and spikes are summarized in Tables 4-18 and 4-19 in Subsection 4.5. All of the analytical laboratory data are presented in Appendix H. The sampling schedule is shown on Table 3-3 and discussed in subsection 3.4.

4.3.1 Water Quality, Site No. 1, Southwest Sanitary Landfill

A single set of water samples was obtained from four groundwater monitoring wells (W-22 through W-25) and from

three surface water impoundments in front of the fill face. These samples were analyzed for volatile organic compounds, total organic carbon, phenols, chemical oxygen demand, metals, pH, specific conductance, temperature and volatile organic compounds. These samples were also scheduled for oil and grease analysis, however three of the groundwater samples (W-22, W-24, and W-25) were inadvertently analyzed for petroleum hydrocarbon.

As shown on Table 4-1, the pH values ranged from 6.2 to 7.2 units with the lowest value at well W-24. Specific conductance values varied between 1190 and 7010 umhos/cm. As with the pH the highest specific conductance values were detected in a sample from W-24.

The concentration of total organic carbon varied from 6.2 to 13.5 mg/L in groundwater samples from monitoring wells around the northern, eastern and southern edges of the landfill. However a sample from the monitoring well along the western edge of the landfill had a reported TOC concentration of 1670 mg/L. The TOC concentration in the surface water samples, which were all obtained from sites along the northern edge of the landfill, varied between 6.8 and 11.5 mg/L.

The COD concentrations varied between 32 and 3150 mg/L in the groundwater samples and between 27 and 42 mg/L in the surface water samples. As with TOC the highest COD concentration was reported in the sample from W-24. Total organic carbon and COD are general indicators of contamination and are not referenced to a particular standard.

Total phenol concentrations ranged from less than the detection limit in a sample from well W-25 to a maximum of 435 ug/L in a sample from W-24. Phenol concentrations in surface water samples varied between not detected and 47 ug/L. The Federal Primary Drinking Water Standard for phenolic compounds is 1 ug/L.

A concentration of 1.1 mg/L of soluble copper was detected in a sample from monitoring well W-24. Soluble copper was also reported in the surface water sites in concentrations ranging from 0.013 to 0.034 mg/L. The Federal Primary Drinking Water Standard for copper is 1 mg/L. A cadmium concentration of 0.019 mg/L was also reported in the sample from W-24. This exceeds the Federal Primary Drinking Water Standard for cadmium of 0.010 mg/L. The only other soluble metals reported in samples from the Southwest Landfill were

ROY F. WESTON, INC.

WESTON
DESIGNERS CONSULTANTS

Table 4-1
Summary of Water Quality Results
Site No.1 Southwest Landfill
Selfridge ANGB

Analyte (units)	Detection Limit	Enforceable or Proposed MCL	Well No. Site No.1 Southwest Landfill					
SITE			W-23	W-24	W-25	Pond 1	Pond 2	Pond 3
Total Organic Carbon (mg/l)	0.5	NA	8.0	1.67K	13.5	11.5	9.3	6.8
Total Phenolics (ug/l)	5.0	NSA	5	435	ND	29	ND	47
Chemical Oxygen Demand (mg/l)	5.0	NA	41.0	3,150	134.0	42.0	33.0	27.0
Cadmium (ug/l)	10.0	10	ND	19	NR	ND	ND	ND
Chromium (ug/l)	10.0	50	ND	ND	NR	ND	ND	ND
Copper (ug/l)	10.0	NSA	ND	1100	NR	34	13	29
Lead (ug/l)	10.0	50	20	ND	NR	ND	ND	ND
Nickel (ug/l)	100.0	NSA	ND	ND	NR	ND	ND	ND
Zinc (ug/l)	20.0	NSA	ND	ND	NR	ND	ND	ND
Petroleum Hydrocarbon (mg/l)	0.1	NA	NR	113.0	.8	NR	NR	NR
Oil and Grease (mg/l)	0.1	NA	1.38	NR	NR	ND	0.1	0.2
pH (units)		6.5 - 8.5	7.1	6.2	7.2	NS	NS	NS
Temperature (C)		NA	8	4	3	NS	NS	NS
Specific Conductance (umhos/cm)		NA	1320	7010	1190	NS	NS	NS

M - Million
BB - BOTTLE BROKEN
ND - Not Detected (Less Than Detection Limit)
NR - Not Requested
NS - Not Sampled
NA - Not Applicable
NSA - No Standard Available

0.020 mg/L of lead from well W-23 and 0.040 mg/L of zinc in well W-22. These concentrations are less than the Federal Drinking Water Standards for these compounds.

The oil and grease concentration in the only monitoring well sample for this parameter, W-23, was 1.38 mg/L. Oil and grease concentrations in the surface water samples ranged between not detected and 0.2 mg/L. Petroleum hydrocarbon concentrations ranged from 0.4 mg/L in a sample from W-22 to 113 mg/L in a sample from W-24. The Federal Drinking Water Standard for oil and grease and petroleum compounds is based on the taste and odor threshold of 10 ug/L.

As shown on Table 4-2, volatile organic compounds were not detected in the samples from wells W-22 and W-23. However, in well W-24 seven volatile organics were detected. These include methylene chloride at 84 ug/L, 1,2 trans dichloroethylene at 71 ug/L, toluene at 52 ug/L, vinyl chloride at 45 ug/L, ethyl benzene at 44 ug/L and trichloroethylene at 6.7 ug/L. A 2.0 ug/L concentration of 1,2 trans dichloroethylene was the only volatile organic compound detected in the sample from well W-25.

At the time of the volatile organic resampling, the surface water impoundments were dry; therefore valid VOC data does not exist for these sites. However, in surface water samples from the original round of sampling for which analysis exceeded the recommended holding time by eight days, methylene chloride was the only volatile organic compound detected. These results are presented in Appendix H with the analytical laboratory data. The methylene chloride concentrations in these samples are considered laboratory artifacts.

4.3.2 Water Quality, Site No. 2, Fire Training Area-2 (FTA-2)

A single set of water samples was obtained from three groundwater monitoring wells (W-19 through W-21) and from two surface impoundments within the bermed fire training area. These samples were submitted for laboratory analysis of pH, specific conductance, total organic carbon, phenols and petroleum hydrocarbons. The data are presented on Table 4-3. In addition, the samples were analyzed for volatile organic compounds.

The pH values for the groundwater ranged between 7.1 and 7.4; this is within the Federal Drinking Water Standard of between 5.0 and 9.0.

ROY F WESTON INC

WESTON

DESIGNERS CONSULTANTS

Table 4-2
Summary of Volatile Organic Analysis
Site No.1 Southwest Landfill
Selfridge ANGB

Volatile Compounds	Detection Limit	Enforceable or Proposed MCL	Site No.1 Southwest Landfill						
SITE			W-22	W-23	W-24	W-25	Pond 1*	Pond 2*	Pond 3*
Units of Concentration ug/L									
Benzene	4.0	5.0	ND	ND	51.0	ND	ND	ND	ND
Bromoform	8.0	NSA	ND	ND	ND	ND	ND	ND	ND
Bromomethane	4.0	NSA	ND	ND	ND	ND	ND	ND	ND
Carbon Tetrachloride	2.0	1.0	ND	ND	ND	ND	ND	ND	ND
Chlorobenzene	2.0	NSA	ND	ND	ND	ND	ND	ND	ND
Chlorodibromomethane	2.0	NSA	ND	ND	ND	ND	ND	ND	ND
Chloroethane	2.0	NSA	ND	ND	ND	ND	ND	ND	ND
2-Chloroethylvinyl Ether	2.0	NSA	ND	ND	ND	ND	ND	ND	ND
Chloroform	2.0	100	ND	ND	ND	ND	ND	ND	ND
Chloromethane	4.0	NSA	ND	ND	ND	ND	ND	ND	ND
Dichlorobromomethane	2.0	NSA	ND	ND	ND	ND	ND	ND	ND
Dichlorodifluoromethane	4.0	NSA	ND	ND	ND	ND	ND	ND	ND
1,2-Dichlorobenzene	3.0	NSA	ND	ND	ND	ND	ND	ND	ND
1,3-Dichlorobenzene	3.0	NSA	ND	ND	ND	ND	ND	ND	ND
1,4-Dichlorobenzene	3.0	750	ND	ND	ND	ND	ND	ND	ND
1,1-Dichloroethane	2.0	NSA	ND	ND	ND	ND	ND	ND	ND
1,2-Dichloroethane	2.0	5.0	ND	ND	ND	ND	ND	ND	ND
1,1-Dichloroethylene	2.0	7.0	ND	ND	71.0	2.0	ND	ND	ND
1,2-Trans Dichloroethylene	2.0	NSA	ND	ND	ND	ND	ND	ND	ND
1,2-Dichloropropane	2.0	NSA	ND	ND	ND	ND	ND	ND	ND
1,3-Trans Dichloropropane	6.0	NSA	ND	ND	ND	ND	ND	ND	ND
1,3-Cis Dichloropropane	2.0	NSA	ND	ND	44.0	ND	ND	ND	ND
Ethyl Benzene	2.0	NSA	ND	ND	84.0	ND	4.8	4.7	4.8
Methylene Chloride	3.0	NSA	ND	ND	ND	ND	ND	ND	ND
1,1,2,2-Tetrachloroethane	2.0	NSA	ND	ND	ND	ND	ND	ND	ND
Tetrachloroethylene	4.0	NSA	ND	ND	52.0	ND	ND	ND	ND
Toluene	2.0	NSA	ND	ND	ND	ND	ND	ND	ND
1,1,1-Trichloroethane	2.0	200	ND	ND	ND	ND	ND	ND	ND
1,1,2-Trichloroethane	2.0	NSA	ND	ND	6.7	ND	ND	ND	ND
Trichloroethylene	2.0	5.0	ND	ND	ND	ND	ND	ND	ND
Trichlorofluoromethane	3.0	NSA	ND	ND	45.0	ND	ND	ND	ND
Vinyl Chloride	4.0	1.0	ND	ND	ND	ND	ND	ND	ND
Xylene	2.0	NSA							

* - Recommended Holding Time Exceeded
ND - Not Detected (Less Than Detection Limit)
NR - Not Requested
N - Not Reported
NSA - No Standard Available

ROY F. WESTON, INC.

WESTON
DESIGNERS CONSULTANTS

Table 4-3
Summary of Water Quality Results
Site No.2 Fire Training Area-2
Selfridge ANGB

Analyte (units)	Detection Limit	Enforceable or Proposed MCL	Well No. W-19	W-20	W-21	Site No.2 Fire Training Area - 2 Pond A	Pond B
SITE							
Total Organic Carbon (mg/l)	0.5	NA	8.5	37.5	28.1	165.0	93.0
Total Phenolics (ug/l)	5.0	NSA	8	17	7	147	96
Chemical Oxygen Demand (mg/l)	5.0	NA	NR	NR	NR	NR	NR
Cadmium (ug/l)	10.0	10	NR	NR	NR	NR	NR
Chromium (ug/l)	10.0	50	NR	NR	NR	NR	NR
Copper (ug/l)	10.0	NSA	NR	NR	NR	NR	NR
Lead (ug/l)	10.0	50	NR	NR	NR	NR	NR
Nickel (ug/l)	100.0	NSA	NR	NR	NR	NR	NR
Zinc (ug/l)	20.0	NSA	NR	NR	NR	NR	NR
Petroleum Hydrocarbon (mg/l)	0.1	NA	1.1	2.0	2.4	4.5	69.0
Oil and Grease (mg/l)	0.1	NA	NR	NR	NR	NR	NR
pH (units)		6.5 - 8.5	7.5	7.4	7.1	NS	NS
Temperature (C)		NA	10	8	9	NS	NS
Specific Conductance (umhos/cm)		NA	3290	8600	1580	NS	NS

M - Million
BB - BOTTLE BROKEN
ND - Not Detected (Less Than Detection Limit)
NR - Not Requested
NS - Not Sampled
NA - Not Applicable
NSA - No Standard Available

Specific conductivities of the groundwater samples varied from 1580 umhos/cm at W-21 to 8600 umhos/cm at W-20. Specific conductance is a general indicator of contamination and is not associated with an enforceable water quality standard.

Total organic carbon concentrations in the wells adjacent to the burn pit, W-20 and W-21 were reported to be 37.5 and 28.1 mg/L, respectively. The TOC concentration in the well W-19, which is upgradient of the burn pit, was 8.5 mg/L. In the surface water sample from the center of the pit the TOC concentration was reported to be 165 mg/L whereas the TOC concentration in the ponded water along the eastern edge of the berm was 93 mg/L.

The phenol concentrations ranged from 8 ug/L in the upgradient monitor well (W-19) to 7 and 17 ug/L in the monitor wells immediately adjacent to the burn pit (W-21 and W-20, respectively).

Petroleum hydrocarbon concentrations in the groundwater samples from FTA increased from 1.1 mg/L in the upgradient well (W-19) to 2.0 and 2.4 mg/L in the wells adjacent to the burn pit (W-20 and W-21, respectively). The petroleum hydrocarbon concentrations of the ponded water sampled increased from 4.5 mg/L at the center of the pit to 69.0 mg/L at the eastern edge of the pit.

As shown on Table 4-4, no volatile organic compounds were detected in May 1985 samples from wells W-19 and W-21. Monitoring well W-20 was destroyed during the course of a fire training exercise between the initial sampling episode and the resampling round. Consequently, a VOA sample could not be obtained during the May round. In the initial sampling round, methylene chloride and trichloroethylene were detected in concentrations of 6.6 and 2.4 ug/L, respectively. Methylene chloride and trichloroethylene were detected in concentrations of 6.6 and 2.4 ug/L, respectively. Methylene chloride and trichloroethylene were reported in a first round sample from W-21 at levels of 3.8 and 3.2 ug/L, respectively. The methylene chloride concentrations may be potentially due to laboratory contamination.

4.3.3 Water Quality, Site No. 3, Fire Training Area -1 (FTA-1)

A single set of ground water samples was obtained from the monitoring wells (W-16 through W-18) installed around the perimeter of the FTA-1 site. Results of laboratory analysis

Table 4-4
Summary of Volatile Organic Analysis
Site No.2 Fire Training Area
Selfridge ANGB

Volatile Compounds	Detection Limit	Enforceable or Proposed MCL	Site No.2 Fire Training Area-2					
SITE			W-19	W-20*	W-20A*	W-21	Pond A*	Pond B*
Units of Concentration ug/L								
Benzene	4.0	5.0	ND	ND	ND	ND	16.0	ND
Bromoform	8.0	NSA	ND	ND	ND	ND	ND	ND
Bromomethane	4.0	NSA	ND	ND	ND	ND	ND	ND
Carbon Tetrachloride	2.0	1.0	ND	ND	ND	ND	ND	ND
Chlorobenzene	2.0	NSA	ND	ND	ND	ND	ND	ND
Chlorodibromomethane	2.0	NSA	ND	ND	ND	ND	ND	ND
Chloroethane	2.0	NSA	ND	ND	ND	ND	ND	ND
2-Chloroethylvinyl Ether	2.0	NSA	ND	ND	ND	ND	ND	ND
Chloroform	2.0	100	ND	ND	ND	ND	6.0	5.6
Chloromethane	4.0	NSA	ND	ND	ND	ND	ND	ND
Dichlorobromomethane	2.0	NSA	ND	ND	ND	ND	ND	ND
Dichlorodifluoromethane	4.0	NSA	ND	ND	ND	ND	3.8	ND
1,2-Dichlorobenzene	3.0	NSA	ND	ND	ND	ND	14.0	14.0
1,3-Dichlorobenzene	3.0	NSA	ND	ND	ND	ND	ND	ND
1,4-Dichlorobenzene	3.0	750	ND	ND	ND	ND	ND	ND
1,1-Dichloroethane	2.0	NSA	ND	ND	ND	ND	ND	ND
1,2-Dichloroethane	2.0	5.0	ND	ND	ND	ND	ND	ND
1,1-Dichloroethylene	2.0	7.0	ND	ND	ND	ND	ND	ND
1,2-Trans Dichloroethylene	2.0	NSA	ND	ND	ND	ND	ND	ND
1,2-Dichloropropane	2.0	NSA	ND	ND	ND	ND	ND	ND
1,3-Trans Dichloropropane	6.0	NSA	ND	ND	ND	ND	ND	ND
1,3-Cis Dichloropropane	2.0	NSA	ND	ND	ND	ND	ND	ND
Ethyl Benzene	2.0	NSA	ND	ND	ND	ND	ND	ND
Methylene Chloride	3.0	NSA	ND	5.2	6.6	ND	13.0	8.5
1,1,2,2-Tetrachloroethane	2.0	NSA	ND	ND	ND	ND	ND	ND
Tetrachloroethylene	4.0	NSA	ND	ND	ND	ND	ND	ND
Toluene	2.0	NSA	ND	ND	ND	ND	34.0	5.5
1,1,1-Trichloroethane	2.0	200	ND	ND	ND	ND	4.9	ND
1,1,2-Trichloroethane	2.0	NSA	ND	ND	ND	ND	ND	ND
Trichloroethylene	2.0	5.0	ND	ND	2.4	ND	3.0	3.0
Trichlorofluoromethane	3.0	NSA	ND	ND	ND	ND	6.0	ND
Vinyl Chloride	4.0	1.0	ND	ND	ND	ND	ND	ND
Xylene	2.0	NSA	ND	ND	ND	ND	ND	ND

* - Recommended Holding Time Exceeded
ND - Not Detected (Less Than Detection Limit)
NR - Not Requested
N - Not Reported
NSA - No Standard Available

for pH, specific conductance, total organic carbon, petroleum hydrocarbon and phenol are shown on Table 4-5.

The pH values in the groundwater samples from FTA-1 range from 6.7 to 7.2 units. Specific conductance was nearly uniform in the three samples varying between 1080 and 1110 umhos/cm. This variation is within the instrument drift range.

Total organic carbon concentrations ranged from 4.3 mg/L in a sample from well W-18 to 5.7 mg/L in a sample obtained from well W-17.

Petroleum hydrocarbon concentrations varied between 0.3 mg/L in a sample from W-17 to 1.0 mg/L in a sample from W-18.

Phenol was detected in a sample from W-18 at a concentration of 7 ug/L. The phenol sample bottle from well W-16 was broken during transit; therefore no phenol data exists for this well.

No volatile organic compounds were detected in the groundwater samples from FTA-1; these results are shown on Table 4-6.

4.3.4 Water Quality, Site No. 4, West Ramp

A single set of groundwater samples was obtained from the five wells installed around the perimeter of the West Ramp and in the vicinity of the January 1984 fuel spill site. The results of analysis of these samples for pH, specific conductance, total organic carbon and petroleum hydrocarbon are presented on Table 4-7.

The pH values of groundwater samples from the West Ramp monitoring wells varied between 6.8 and 7.4.

Specific conductance in the sample from W-11 was reported to be 777 umhos/cm. The specific conductance in the remainder of the groundwater samples from the West Ramp varied between 1010 and 1300 umhos/cm.

Monitoring well W-11 is located in a depression between the hangars and the West Ramp and is frequently surrounded by ponded runoff water. The continual infiltration of this water may account for the lower specific conductance value at W-11.

ROY F. WESTON, INC.

WESTON DESIGNERS CONSULTANTS

Table 4-5
Summary of Water Quality Results
Site No.3 Fire Training Area-1
Selfridge ANGB

Analyte (units)	Detection Limit	Enforceable or Proposed MCL	Well No. Site No.3 :--Fire Taining Area - 1--: W-16	W-17	W-18
SITE					
Total Organic Carbon (mg/l)	0.5	NA	5.2	5.7	4.3
Total Phenolics (ug/l)	5.0	NSA	BB	ND	7
Chemical Oxygen Demand (mg/l)	5.0	NA	NR	NR	NR
Cadmium (ug/l)	10.0	10	NR	NR	NR
Chromium (ug/l)	10.0	50	NR	NR	NR
Copper (ug/l)	10.0	NSA	NR	NR	NR
Lead (ug/l)	10.0	50	NR	NR	NR
Nickel (ug/l)	100.0	NSA	NR	NR	NR
Zinc (ug/l)	20.0	NSA	NR	NR	NR
Petroleum Hydrocarbon (mg/l)	0.1	NA	0.7	0.3	1.0
Oil and Grease (mg/l)	0.1	NA	NR	NR	NR
pH (units)		6.5 - 8.5	6.7	6.8	7.2
Temperature (C)		NA	5	5	8
Specific Conductance (umhos/cm)		NA	1080	1110	1080

M - Million
BB - BOTTLE BROKEN
ND - Not Detected (Less Than Detection Limit,
NR - Not Requested
NS - Not Sampled
NA - Not Applicable
NSA - No Standard Available

Table 4-6

Summary of Volatile Organic Analysis
Site No.3 Fire Training Area 1
Selfridge ANGB

Volatile Compounds	Detection Limit	Enforceable or Proposed MCL	Site No.3 Fire Training Area 1		
SITE			W-16	W-17	W-18
Units of Concentration ug/L					
Benzene	4.0	5.0	ND	ND	ND
Bromoform	8.0	NSA	ND	ND	ND
Bromomethane	4.0	NSA	ND	ND	ND
Carbon Tetrachloride	2.0	1.0	ND	ND	ND
Chlorobenzene	2.0	NSA	ND	ND	ND
Chlorodibromomethane	2.0	NSA	ND	ND	ND
Chloroethane	2.0	NSA	ND	ND	ND
2-Chloroethylvinyl Ether	2.0	NSA	ND	ND	ND
Chloroform	2.0	100	ND	ND	ND
Chloromethane	4.0	NSA	ND	ND	ND
Dichlorobromomethane	2.0	NSA	ND	ND	ND
Dichlorodifluoromethane	4.0	NSA	ND	ND	ND
1,2-Dichlorobenzene	3.0	NSA	ND	ND	ND
1,3-Dichlorobenzene	3.0	NSA	ND	ND	ND
1,4-Dichlorobenzene	3.0	750	ND	ND	ND
1,1-Dichloroethane	2.0	NSA	ND	ND	ND
1,2-Dichloroethane	2.0	5.0	ND	ND	ND
1,1-Dichloroethylene	2.0	7.0	ND	ND	ND
1,2-Trans Dichloroethylene	2.0	NSA	ND	ND	ND
1,2-Dichloropropane	2.0	NSA	ND	ND	ND
1,3-Trans Dichloropropane	6.0	NSA	ND	ND	ND
1,3-Cis Dichloropropane	2.0	NSA	ND	ND	ND
Ethyl Benzene	2.0	NSA	ND	ND	ND
Methylene Chloride	3.0	NSA	ND	ND	ND
1,1,2,2-Tetrachloroethane	2.0	NSA	ND	ND	ND
Tetrachloroethylene	4.0	NSA	ND	ND	ND
Toluene	2.0	NSA	ND	ND	ND
1,1,1-Trichloroethane	2.0	200	ND	ND	ND
1,1,2-Trichloroethane	2.0	NSA	ND	ND	ND
Trichloroethylene	2.0	5.0	ND	ND	ND
Trichlorofluoromethane	3.0	NSA	ND	ND	ND
Vinyl Chloride	4.0	1.0	ND	ND	ND
Xylene	2.0	NSA			

ND - Not Detected (Less Than Detection Limit)
NR - Not Requested
N - Not Reported
NSA - No Standard Available

ROY F. WESTON, INC.

WESTON DESIGNERS CONSULTANTS

Table 4-7

Summary of Water Quality Results
Site No.4 West Ramp
Selfridge ANGB

Analyte (units)	Detection Limit	Enforceable or Proposed MCL	Site No.4 West Ramp				
SITE			W-11	W-12	W-13	W-14	W-15
Total Organic Carbon (mg/l)	0.5	NA	11.2	8.2	9.4	11.3	12.0
Total Phenolics (ug/l)	5.0	NSA	NR	NR	NR	NR	NR
Chemical Oxygen Demand (mg/l)	5.0	NA	NR	NR	NR	NR	NR
Cadmium (ug/l)	10.0	10	NR	NR	NR	NR	NR
Chromium (ug/l)	10.0	50	NR	NR	NR	NR	NR
Copper (ug/l)	10.0	NSA	NR	NR	NR	NR	NR
Lead (ug/l)	10.0	50	NR	NR	NR	NR	NR
Nickel (ug/l)	100.0	NSA	NR	NR	NR	NR	NR
Zinc (ug/l)	20.0	NSA	NR	NR	NR	NR	NR
Petroleum Hydrocarbon (mg/l)	0.1	NA	1.3	1.0	1.9	2.4	1.0
Oil and Grease (mg/l)	0.1	NA	NR	NR	NR	NR	NR
pH (units)		6.5 - 8.5	7.1	7.1	6.8	7.2	7.4
Temperature (C)		NA	10	11	11	9	9
Specific Conductance (umhos/cm)		NA	777	1300	1150	1110	1010

M - Million
BB - BOTTLE BROKEN
ND - Not Detected (Less Than Detection Limit)
NR - Not Requested
NS - Not Sampled
NA - Not Applicable
NSA - No Standard Available

Total organic carbon concentrations ranged from a low of 8.2 to 9.6 mg/L in samples from wells W-12 and W-13 to a maximum range of 11.2 to 12.0 in samples from wells W-11, W-14 and W-15. Monitoring well W-15 is located near the source of the January 1984 fuel spill. Well W-11 is located in the depression in which the fuel from the January 1984 spill accumulated.

Concentration levels of petroleum hydrocarbon varied between 1.0 and 2.4 mg/L in the groundwater samples from the West Ramp.

As shown on Table 4-8, the only reported concentrations of volatile organics in the wells from the West Ramp were 2.3 and 2.5 ug/L of trichloroethylene in samples from wells W-11 and W-14 and 4.7 ug/L of methylene chloride in a sample from well W-14. The detection limits for trichloroethylene and methylene chloride are 2.0 and 3.0 ug/L respectively.

4.3.5 Water Quality, Site No. 5, Tucker Creek Landfill

A single set of groundwater samples was obtained from three monitoring wells (W-5 through W-7) installed around the perimeter of Tucker Creek Landfill. These samples were analyzed for pH, specific conductance, TOC, total phenolics, COD, soluble metals, oil and grease and volatile organic carbon.

As shown on Table 4-9, the pH values of the groundwater samples from Tucker Creek varied slightly between 6.9 and 7.0 units.

The specific conductance varied between 2590 umhos/cm in a sample from W-6 to 3700 umhos/cm in a sample from well W-7.

Total organic carbon concentrations in samples from the Tucker Creek Landfill monitoring wells increased from 8.0 mg/L in the upgradient monitoring well (W-5) to 11.7 and 16.4 mg/L in the downgradient wells (W-7 and W-6, respectively).

Phenols were detected at a concentration of 40 ug/L at the upgradient well W-5, but was not detected in either of the downgradient wells W-6 and W-7.

A similar increase in COD concentrations was reported in the analytical results. The COD levels increased from 194 mg/L in W-5 to 218 and 644 mg/L in wells W-6 and W-7.

ROY F. WESTON, INC.
WESTON
DESIGNERS CONSULTANTS

Table 4-8
Summary of Volatile Organic Analysis
Site No.4 West Ramp
Selfridge ANGB

Volatile Compounds	Detection Limit	Enforceable or Proposed MCL	Site No.4 West Ramp				
SITE			W-11	W-12	W-13	W-14	W-15
Units of Concentration ug/L							
Benzene	4.0	5.0	ND	ND	ND	ND	ND
Bromoform	8.0	NSA	ND	ND	ND	ND	ND
Bromomethane	4.0	NSA	ND	ND	ND	ND	ND
Carbon Tetrachloride	2.0	1.0	ND	ND	ND	ND	ND
Chlorobenzene	2.0	NSA	ND	ND	ND	ND	ND
Chlorodibromomethane	2.0	NSA	ND	ND	ND	ND	ND
Chloroethane	2.0	NSA	ND	ND	ND	ND	ND
2-Chloroethylvinyl Ether	2.0	NSA	ND	ND	ND	ND	ND
Chloroform	2.0	100	ND	ND	ND	ND	ND
Chloromethane	4.0	NSA	ND	ND	ND	ND	ND
Dichlorobromomethane	2.0	NSA	ND	ND	ND	ND	ND
Dichlorodifluoromethane	4.0	NSA	ND	ND	ND	ND	ND
1,2-Dichlorobenzene	3.0	NSA	ND	ND	ND	ND	ND
1,3-Dichlorobenzene	3.0	NSA	ND	ND	ND	ND	ND
1,4-Dichlorobenzene	3.0	750	ND	ND	ND	ND	ND
1,1-Dichloroethane	2.0	NSA	ND	ND	ND	ND	ND
1,2-Dichloroethane	2.0	5.0	ND	ND	ND	ND	ND
1,1-Dichloroethylene	2.0	7.0	ND	ND	ND	ND	ND
1,2-Trans Dichloroethylene	2.0	NSA	ND	ND	ND	ND	ND
1,2-Dichloropropane	2.0	NSA	ND	ND	ND	ND	ND
1,3-Trans Dichloropropane	6.0	NSA	ND	ND	ND	ND	ND
1,3-Cis Dichloropropane	2.0	NSA	ND	ND	ND	ND	ND
Ethyl Benzene	2.0	NSA	ND	ND	ND	ND	ND
Methylene Chloride	3.0	NSA	ND	ND	ND	4.7	ND
1,1,2,2-Tetrachloroethane	2.0	NSA	ND	ND	ND	ND	ND
Tetrachloroethylene	4.0	NSA	ND	ND	ND	ND	ND
Toluene	2.0	NSA	ND	ND	ND	ND	ND
1,1,1-Trichloroethane	2.0	200	ND	ND	ND	ND	ND
1,1,2-Trichloroethane	2.0	NSA	ND	ND	ND	ND	ND
Trichloroethylene	2.0	5.0	2.3	ND	ND	2.5	ND
Trichlorofluoromethane	3.0	NSA	ND	ND	ND	ND	ND
Vinyl Chloride	4.0	1.0	ND	ND	ND	ND	ND
Xylene	2.0	NSA	ND	ND	ND	ND	ND

ND - Not Detected (Less Than Detection Limit)
NR - Not Requested
N - Not Reported
NSA - No Standard Available

Table 4-9

Summary of Water Quality Results
Site No.5 Tucker Creek Landfill
Selfridge ANGB

Analyte (units)	Detection Limit	Enforceable or Proposed MCL	Well No. Site No.5 :--Tucker Creek Landfill--: W-5	W-6	W-7
SITE					
Total Organic Carbon (mg/l)	0.5	NA	8.0	16.4	11.1
Total Phenolics (ug/l)	5.0	NSA	10	ND	ND
Chemical Oxygen Demand (mg/l)	5.0	NA	194.0	218.0	688.0
Cadmium (ug/l)	10.0	10	14	ND	ND
Chromium (ug/l)	10.0	50	ND	ND	ND
Copper (ug/l)	10.0	NSA	1900	14	32
Lead (ug/l)	10.0	50	44	ND	ND
Nickel (ug/l)	100.0	NSA	ND	ND	ND
Zinc (ug/l)	20.0	NSA	ND	ND	ND
Petroleum Hydrocarbon (mg/l)	0.1	NA	NR	NR	NR
Oil and Grease (mg/l)	0.1	NA	1.17	.44	.77
pH (units)		6.5 - 8.5	7.0	7.0	6.9
Temperature (C)		NA	10	12	10
Specific Conductance (umhos/cm)		NA	2630	2590	3700

M - Million
BB - BOTTLE BROKEN
ND - Not Detected (Less Than Detection Limit)
NR - Not Requested
NS - Not Sampled
NA - Not Applicable
NSA - No Standard Available

(t)

Detectable levels of soluble cadmium (0.014 mg/L), copper (1.9 mg/L) and lead (0.044 mg/L) were reported in the sample from well W-5. Soluble copper was also detected in monitoring wells W-6 and W-7 at concentrations of 0.014 and 0.034 mg/L respectively. No other soluble metal concentrations were reported in the samples from the Tucker Creek Landfill. Monitoring well W-5 is located near a catchment basin which receives surface water runoff from a large area west of Jefferson Avenue. Therefore, it is possible that any contaminants present in well W-5, such as copper, may not have originated in the Tucker Creek Landfill.

The oil and grease concentrations reported in samples from monitoring wells W-5, W-6 and W-7 were 1.17, 0.44 and 0.77 mg/L respectively.

As shown on Table 4-10, trichloroethylene was the only volatile organic compound detected in the Tucker Creek Landfill groundwater samples. Trichloroethylene was reported in samples from all three of the monitoring wells at this site at levels between 2.2 and 3.1 ug/L.

4.3.6 Water Quality, Site No. 6, Northwest Landfill

A single set of groundwater samples was obtained from three wells (W-8 through W-10) installed around the perimeter of the Northwest Landfill. Laboratory analysis of pH, specific conductance, TOC, total phenols, COD, soluble metals and oil and grease are shown on Table 4-11.

The pH values of groundwater samples from the Northwest Landfill ranged from 6.8 at well W-8 to 7.5 at wells W-9 and W-10.

The specific conductance varied from 404 umhos/cm in the upgradient well, W-10, to 983 and 1450 in the downgradient wells (W-9 and W-8, respectively).

The total organic carbon in the Northwest Landfill groundwater samples varied between 12.2 mg/L at well W-9 to 52 mg/L at well W-10.

Phenols were reported in samples from wells W-8 and W-9 at concentrations of 15 and 13 ug/L, respectively. Phenols were not detected in the sample from well W-10.

Chemical Oxygen Demand levels ranged from 63 mg/L at W-8 to 320 mg/L at W-10 to 565 mg/L at W-9.

ROY F. WESTON, INC
WESTON
DESIGNERS CONSULTANTS

Table 4-10

Summary of Volatile Organic Analysis
Site No.5 Tucker Creek Landfill
Selfridge ANGB

Volatile Compounds	Detection Limit	Enforceable or Proposed MCL	Site No.5 Tucker Creek Landfill		
SITE			W-5	W-6	W-7
Units of Concentration ug/L					
Benzene	4.0	5.0	ND	ND	ND
Bromoform	8.0	NSA	ND	ND	ND
Bromomethane	4.0	NSA	ND	ND	ND
Carbon Tetrachloride	2.0	1.0	ND	ND	ND
Chlorobenzene	2.0	NSA	ND	ND	ND
Chlorodibromomethane	2.0	NSA	ND	ND	ND
Chloroethane	2.0	NSA	ND	ND	ND
2-Chloroethylvinyl Ether	2.0	NSA	ND	ND	ND
Chloroform	2.0	100	ND	ND	ND
Chloromethane	4.0	NSA	ND	ND	ND
Dichlorobromomethane	2.0	NSA	ND	ND	ND
Dichlorodifluoromethane	4.0	NSA	ND	ND	ND
1,2-Dichlorobenzene	3.0	NSA	ND	ND	ND
1,3-Dichlorobenzene	3.0	NSA	ND	ND	ND
1,4-Dichlorobenzene	3.0	750	ND	ND	ND
1,1-Dichloroethane	2.0	NSA	ND	ND	ND
1,2-Dichloroethane	2.0	5.0	ND	ND	ND
1,1-Dichloroethylene	2.0	7.0	ND	ND	ND
1,2-Trans Dichloroethylene	2.0	NSA	ND	ND	ND
1,2-Dichloropropane	2.0	NSA	ND	ND	ND
1,3-Trans Dichloropropane	6.0	NSA	ND	ND	ND
1,3-Cis Dichloropropane	2.0	NSA	ND	ND	ND
Ethyl Benzene	2.0	NSA	ND	ND	ND
Methylene Chloride	3.0	NSA	ND	ND	ND
1,1,2,2-Tetrachloroethane	2.0	NSA	ND	ND	ND
Tetrachloroethylene	4.0	NSA	ND	ND	ND
Toluene	2.0	NSA	ND	ND	ND
1,1,1-Trichloroethane	2.0	200	ND	ND	ND
1,1,2-Trichloroethane	2.0	NSA	ND	ND	ND
Trichloroethylene	2.0	5.0	2.2	2.4	3.1
Trichlorofluoromethane	3.0	NSA	ND	ND	ND
Vinyl Chloride	4.0	1.0	ND	ND	ND
Xylene	2.0	NSA	ND	ND	ND

ND - Not Detected (Less Than Detection Limit)
NR - Not Requested
N - Not Reported
NSA - No Standard Available

ROY F. WESTON, INC.

WESTON

DESIGNERS CONSULTANTS

Table 4-11

Summary of Water Quality Results
Site No.6 Northwest Landfill
Selfridge ANGB

Analyte (units)	Detection Limit	Enforceable or Proposed MCL	Well No. :----Northwest Landfill---: Site No. 6		
SITE			W-8	W-9	W-10
Total Organic Carbon (mg/l)	0.5	NA	22.9	12.2	52.0
Total Phenolics (ug/l)	5.0	NSA	15	13	ND
Chemical Oxygen Demand (mg/l)	5.0	NA	63.0	565.0	320.0
Cadmium (ug/l)	10.0	10	ND	ND	ND
Chromium (ug/l)	10.0	50	ND	ND	ND
Copper (ug/l)	10.0	NSA	ND	1100	1600
Lead (ug/l)	10.0	50	24	ND	11
Nickel (ug/l)	100.0	NSA	ND	ND	ND
Zinc (ug/l)	20.0	NSA	ND	ND	ND
Petroleum Hydrocarbon (mg/l)	0.1	NA	NR	NR	NR
Oil and Grease (mg/l)	0.1	NA	.32	1.55	3.7
pH (units)		6.5 - 8.5	6.8	7.5	7.5
Temperature (C)		NA	8	9	8
Specific Conductance (umhos/cm)		NA	1450	983	404

M - Million
BB - BOTTLE BROKEN
ND - Not Detected (Less Than Detection Limit)
NR - Not Requested
NS - Not Sampled
NA - Not Applicable
NSA - No Standard Available

imit)

The results of these general contaminant indicators suggest that although groundwater contamination exists at this site, a well defined plume or pattern cannot be defined from the existing well network.

Soluble copper was reported in sampling from wells W-9 and W-10 at concentrations of 1.1 and 1.6 mg/L respectively. The only other reported concentrations of soluble metals were 0.011 and 0.024 mg/L of lead from wells W-10 and W-5 respectively. Oil and grease concentrations varied from 0.32 mg/L in a sample from W-8 to 3.7 mg/L in the upgradient well (W-10).

Data on Table 4-12 show that the only volatile organic concentration detected in the Northwest Landfill groundwater samples was 2.2 ug/L of trichloroethylene in well W-8.

4.3.7 Water Quality, Site No. 7, East Ramp

A single set of samples was obtained from four wells installed near the corners of the East Ramp. These samples were submitted for laboratory analysis of pH, specific conductance, TOC, petroleum hydrocarbon (Table 4-13) and volatile organic compounds (Table 4-14).

The pH values of the groundwater samples from the East Ramp vary between 7.0 and 7.4, with the highest value reported in the sample from W-3.

The specific conductance of the groundwater beneath the East Ramp ranges from 534 umhos/cm at well W-2 to 1140 umhos/cm at well W-3.

The TOC concentration increased from a range of 3.1 to 5.1 mg/L in the samples from the eastern portion of the ramp (W-2 and W-3) to a range of 6.3 to 9.8 in the western sampling sites (W-1 and W-4).

The petroleum hydrocarbon concentrations varied between 0.6 and 0.8 mg/L in samples from wells W-1, W-2, and W-4, but increased to 9.2 mg/L in the sample from W-3.

Trichloroethylene was the only volatile organic compound detected in the groundwater samples from the East Ramp. Trichloroethylene concentrations of 9.0 and 4.9 ug/L were reported in samples from wells W-1 and W-2.

Table 4-12
Summary of Volatile Organic Analysis
Site No.6 Northwest Landfill
Selfridge ANGB

Volatile Compounds	Detection Limit	Enforceable or Proposed MCL	Site No.6 Northwest Landfill		
SITE					
Units of Concentration ug/L			W-8	W-9	W-10
Benzene	4.0	5.0			
Bromoform	8.0	NSA	ND	ND	ND
Bromomethane	4.0	NSA	ND	ND	ND
Carbon Tetrachloride	2.0	1.0	ND	ND	ND
Chlorobenzene	2.0	NSA	ND	ND	ND
Chlorodibromomethane	2.0	NSA	ND	ND	ND
Chloroethane	2.0	NSA	ND	ND	ND
2-Chloroethylvinyl Ether	2.0	NSA	ND	ND	ND
Chloroform	2.0	100	ND	ND	ND
Chloromethane	4.0	NSA	ND	ND	ND
Dichlorobromomethane	2.0	NSA	ND	ND	ND
Dichlorodifluoromethane	4.0	NSA	ND	ND	ND
1,2-Dichlorobenzene	3.0	NSA	ND	ND	ND
1,3-Dichlorobenzene	3.0	NSA	ND	ND	ND
1,4-Dichlorobenzene	3.0	750	ND	ND	ND
1,1-Dichloroethane	2.0	NSA	ND	ND	ND
1,2-Dichloroethane	2.0	5.0	ND	ND	ND
1,1-Dichloroethylene	2.0	7.0	ND	ND	ND
1,2-Trans Dichloroethylene	2.0	NSA	ND	ND	ND
1,2-Dichloropropane	2.0	NSA	ND	ND	ND
1,3-Trans Dichloropropane	6.0	NSA	ND	ND	ND
1,3-Cis Dichloropropane	2.0	NSA	ND	ND	ND
Ethyl Benzene	2.0	NSA	ND	ND	ND
Methylene Chloride	3.0	NSA	ND	ND	ND
1,1,2,2-Tetrachloroethane	2.0	NSA	ND	ND	ND
Tetrachloroethylene	4.0	NSA	ND	ND	ND
Toluene	2.0	NSA	ND	ND	ND
1,1,1-Trichloroethane	2.0	200	ND	ND	ND
1,1,2-Trichloroethane	2.0	NSA	ND	ND	ND
Trichloroethylene	2.0	5.0	ND	ND	ND
Trichlorofluoromethane	3.0	NSA	2.2	ND	ND
Vinyl Chloride	4.0	1.0	ND	ND	ND
Xylene	2.0	NSA	ND	ND	ND
			ND	ND	ND

ND - Not Detected (Less Than Detection Limit)
NR - Not Requested
N - Not Reported
NSA - No Standard Available

ROY F. WESTON, INC.
WESTON
DESIGNERS CONSULTANTS

Table 4-13
Summary of Water Quality Results
Site No.7 East Ramp
Selfridge ANGB

Analyte (units)	Detection Limit	Enforceable or Proposed MCL	Well Number: Site No.7 East Ramp W-1	W-2	W-3	W-4
SITE						
Total Organic Carbon (mg/l)	0.5	NA	9.8	3.1	5.1	6.3
Total Phenolics (ug/l)	5.0	NSA	NR	ND	NR	NR
Chemical Oxygen Demand (mg/l)	5.0	NA	NR	NR	NR	NR
Cadmium (ug/l)	10.0	10	NR	NR	NR	NR
Chromium (ug/l)	10.0	50	NR	NR	NR	NR
Copper (ug/l)	10.0	NSA	NR	NR	NR	NR
Lead (ug/l)	10.0	50	NR	NR	NR	NR
Nickel (ug/l)	100.0	NSA	NR	NR	NR	NR
Zinc (ug/l)	20.0	NSA	NR	NR	NR	NR
Petroleum Hydrocarbon (mg/l)	0.1	NA	0.7	0.8	9.2	0.6
Oil and Grease (mg/l)	0.1	NA	NR	NR	NR	NR
pH (units)		6.5 - 8.5	7.0	7.1	7.4	7.1
Temperature (C)		NA	14	15	11	10
Specific Conductance (umhos/cm)		NA	758	534	1140	839

M - Million
BB - BOTTLE BROKEN
ND - Not Detected (Less Than Detection Limit)
NR - Not Requested
NS - Not Sampled
NA - Not Applicable
NSA - No Standard Available

ROY F. WESTON, INC.
WESTON
DESIGNERS CONSULTANTS

Table 4-14
Summary of Volatile Organic Analyses
Site No.7 East Ramp
Selfridge ANGB

Volatile Compounds	Detection Limit	Enforceable or Proposed MCL	Site No.7 East Ramp			
SITE			W-1	W-2	W-3	W-4
Units of Concentration ug/L						
Benzene	4.0	5.0	ND	ND	ND	ND
Bromoform	8.0	NSA	ND	ND	ND	ND
Bromomethane	4.0	NSA	ND	ND	ND	ND
Carbon Tetrachloride	2.0	1.0	ND	ND	ND	ND
Chlorobenzene	2.0	NSA	ND	ND	ND	ND
Chlorodibromomethane	2.0	NSA	ND	ND	ND	ND
Chloroethane	2.0	NSA	ND	ND	ND	ND
2-Chloroethylvinyl Ether	2.0	NSA	ND	ND	ND	ND
Chloroform	2.0	100	ND	ND	ND	ND
Chloromethane	4.0	NSA	ND	ND	ND	ND
Dichlorobromomethane	2.0	NSA	ND	ND	ND	ND
Dichlorodifluoromethane	4.0	NSA	ND	ND	ND	ND
1,2-Dichlorobenzene	3.0	NSA	ND	ND	ND	ND
1,3-Dichlorobenzene	3.0	NSA	ND	ND	ND	ND
1,4-Dichlorobenzene	3.0	750	ND	ND	ND	ND
1,1-Dichloroethane	2.0	NSA	ND	ND	ND	ND
1,2-Dichloroethane	2.0	5.0	ND	ND	ND	ND
1,1-Dichloroethylene	2.0	7.0	ND	ND	ND	ND
1,2-Trans Dichloroethylene	2.0	NSA	ND	ND	ND	ND
1,2-Dichloropropane	2.0	NSA	ND	ND	ND	ND
1,3-Trans Dichloropropane	6.0	NSA	ND	ND	ND	ND
1,3-Cis Dichloropropane	2.0	NSA	ND	ND	ND	ND
Ethyl Benzene	2.0	NSA	ND	ND	ND	ND
Methylene Chloride	3.0	NSA	ND	ND	ND	ND
1,1,2,2-Tetrachloroethane	2.0	NSA	ND	ND	ND	ND
Tetrachloroethylene	4.0	NSA	ND	ND	ND	ND
Toluene	2.0	NSA	ND	ND	ND	ND
1,1,1-Trichloroethane	2.0	200	ND	ND	ND	ND
1,1,2-Trichloroethane	2.0	NSA	ND	ND	ND	ND
Trichloroethylene	2.0	5.0	3.0	4.9	ND	ND
Trichlorofluoromethane	3.0	NSA	ND	ND	ND	ND
Vinyl Chloride	4.0	1.0	ND	ND	ND	ND
Xylene	2.0	NSA	ND	ND	ND	ND

ND - Not Detected (Less Than Detection Limit)
NR - Not Requested
N - Not Reported
NSA - No Standard Available

4.4 RESULTS OF SOIL QUALITY ANALYSES

In addition to water quality testing, three soil samples were obtained from each of the borings on the East and West Ramps and submitted for laboratory analysis of oil and grease and volatile organics. The results of these analyses are summarized in Tables 4-15 and 4-16. Results of analyses of quality assurance samples are presented on Table 4-20 in subsection 4.5.

4.4.1 Soil Quality, Site No. 4, West Ramp

Undisturbed soil samples were obtained at the 2.5, 7.5 and 10.5 foot depth intervals of all the borings adjacent to the West Ramp (W-11 through W-15). These intervals were selected on the basis of photoionization meter (HNu) readings taken during the course of drilling. These readings are summarized on the boring logs presented in Appendix D. The samples were submitted for laboratory analysis of oil and grease and volatile organics.

The oil and grease concentrations in the West Ramp soil samples generally ranged between 65 and 223 mg/kg. However, the soil sample from the 2.5 feet level of boring W-15 was reported to have a concentration of 17,900 mg/kg. Boring W-15 is adjacent to the source of the January 1984 fuel spill. With the exception of boring W-15 the oil and grease concentrations at the West Ramp borings site increase with depth in the soil profile.

Benzene, toluene, ethylbenzene, trichloroethylene, trichlorofluoromethane, methylene chloride and chloroform are the most commonly reported volatile organic compounds in the soil samples from the West Ramp.

The volatile organics most commonly associated with hydrocarbon fuels (benzene, toluene and ethyl benzene) were detected in the 2.5 and 7.5 foot interval sample from borings W-11 and W-15 and in the 10.5 foot level sample from boring W-14. The maximum reported concentrations of these compounds were in the 7.5 foot level sample from boring W-15 (See Table 4-16).

Trichloroethylene was reported in every West Ramp soil sample in concentrations ranging from 52 to 1500 ug/g. Methylene chloride was detected in eleven of the fifteen soil samples in concentrations ranging up to 98 ug/g. Trichlorofluromethane was reported in one third of all the samples with the maximum concentration of 29 ug/g occurring in the 10.5 foot level in boring W-14. The maximum

Table 4-15
Summary of Oil and Grease Analysis
Soil Samples
Selfridge ANGB

Site	Well No.	Depth Interval (feet BLS)	Oil and Grease (units of concentration Mg/Kg)
EAST RAMP	W-1	7.5	110
		15.5	121
	W-2	25.5	203
		7.5	118
		15.5	150
		25.0	203
	W-3	7.5	92
		15.5	229
		25.0	163
	W-4	7.5	69
		15.5	148
		25.0	91
WEST RAMP	W-11	2.5	145
		7.5	191
		10.5	177
	W-12	2.5	65
		7.5	197
		10.5	208
	W-13	2.5	107
		7.5	176
		10.5	172
	W-14	2.5	92
		7.5	181
		10.5	215
	W-15	2.5	17,900
		7.5	223
		10.5	133

Table 4-16

Summary of Volatile Organic Analyses - Selfridge ANGB
Soil Samples

Volatile Compounds	Detection Limit	Well Number											
SITE		East Ramp											
		W-1			W-2			W-3			W-4		
Units of Concentration ug/g		7.5	15.5	25.0	7.5	15.5	25.0	7.5	15.5	25.0	7.5	15.5	25.0
Benzene	4.0	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Bromoform	8.0	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Bromomethane	4.0	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Carbon Tetrachloride	2.0	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Chlorobenzene	2.0	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Chlorodibromomethane	2.0	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Chloroethane	2.0	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
2-Chloroethylvinyl Ether	2.0	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Chloroform	2.0	ND	ND	ND	ND	48	ND	ND	160	490	ND	ND	ND
Chloromethane	4.0	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Dichlorobromomethane	2.0	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Dichlorodifluoromethane	4.0	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
1,2-Dichlorobenzene	3.0	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
1,3-Dichlorobenzene	3.0	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
1,4-Dichlorobenzene	3.0	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
1,1-Dichloroethane	2.0	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
1,2-Dichloroethane	2.0	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
1,1-Dichloroethylene	2.0	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
1,2-Trans Dichloroethylene	2.0	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
1,2-Dichloropropane	2.0	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
1,3-Trans Dichloropropane	6.0	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
1,3-Cis Dichloropropane	2.0	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Ethyl Benzene	2.0	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Methylene Chloride	3.0	1,500	1,500	ND	10	140	ND	ND	1,200	1,800	15	62	26
1,1,2,2-Tetrachloroethane	2.0	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Tetrachloroethylene	4.0	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Toluene	2.0	60	58	ND	ND	ND	ND	59	ND	ND	ND	ND	ND
1,1,1-Trichloroethane	2.0	2,100	2,100	1,900	11	ND	ND	ND	ND	380	ND	ND	20
1,1,2-Trichloroethane	2.0	ND	ND	ND	ND	ND	ND	ND	1,000	ND	ND	19	ND
Trichloroethylene	2.0	880	3,600	1,700	550	1,400	300	150	6,600	6,800	280	107	4,000
Trichlorofluoromethane	3.0	ND	ND	ND	17	ND	ND	ND	ND	ND	14	22	28
Vinyl Chloride	4.0	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Xylene	2.0	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND

ND - Not Detected (Less that Detection Limit)
* - Interference with analysis

ROY F. WESTON, INC.

WESTON
DESIGNERS CONSULTANTS

Table 4-16 (cont.)

Volatile Compounds	Detection Limit	Well Number											
SITE		West Ramp											
		W-11			W-12			W-13			W-14		
Units of Concentration ug/g		2.5	7.5	10.5	2.5	7.5	10.5	2.5	7.5	10.5	2.5	7.5	10.5
Benzene	4.0	24	16	ND	ND	ND	ND	ND	ND	ND	ND	ND	8.5
Bromoform	8.0	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Bromomethane	4.0	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Carbon Tetrachloride	2.0	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Chlorobenzene	2.0	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Chlorodibromomethane	2.0	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Chloroethane	2.0	ND	ND	ND	ND	ND	ND	ND	ND	ND	31	ND	ND
2-Chloroethylvinyl Ether	2.0	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Chloroform	2.0	ND	11	13	ND	13	11	ND	ND	ND	ND	ND	13
Chloromethane	4.0	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Dichlorobromomethane	2.0	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Dichlorodifluoromethane	4.0	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
1,2-Dichlorobenzene	3.0	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
1,3-Dichlorobenzene	3.0	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
1,4-Dichlorobenzene	3.0	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
1,1-Dichloroethane	2.0	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
1,2-Dichloroethane	2.0	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
1,1-Dichloroethylene	2.0	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
1,2-Trans Dichloroethylene	2.0	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
1,2-Dichloropropane	2.0	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
1,3-Trans Dichloropropane	6.0	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
1,3-Cis Dichloropropane	2.0	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Ethyl Benzene	2.0	ND	5.2	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Methylene Chloride	3.0	*	5.2	43	15	45	98	23	ND	ND	11	64	52
1,1,2,2-Tetrachloroethane	2.0	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Tetrachloroethylene	4.0	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Toluene	2.0	320	10	ND	ND	ND	ND	ND	ND	ND	ND	ND	5.5
1,1,1-Trichloroethane	2.0	ND	ND	ND	ND	6.1	4.4	ND	ND	ND	ND	ND	11
1,1,2-Trichloroethane	2.0	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Trichloroethylene	2.0	60	640	730	620	1,000	410	240	60	350	1,500	520	1,300
Trichlorofluoromethane	3.0	ND	15	14	ND	12	19	ND	ND	ND	ND	ND	29
Vinyl Chloride	4.0	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Xylene	2.0	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND

ND - Not Detected (Less that Detection Limit)
* - Interference with analysis

Table 4-16 (cont.)

Volatile Compounds	Detection Limit	SITE W-15		
Units of Concentration ug/g		2.5	7.5	10.5
Benzene	4.0	ND	ND	ND
Bromoform	8.0	ND	ND	ND
Bromomethane	4.0	ND	ND	ND
Carbon Tetrachloride	2.0	ND	ND	ND
Chlorobenzene	2.0	ND	ND	ND
Chlorodibromomethane	2.0	ND	ND	ND
Chloroethane	2.0	ND	ND	ND
2-Chloroethylvinyl Ether	2.0	ND	ND	ND
Chloroform	2.0	ND	ND	ND
Chloromethane	4.0	ND	ND	ND
Dichlorobromomethane	2.0	ND	ND	ND
Dichlorodifluoromethane	4.0	ND	ND	ND
1,2-Dichlorobenzene	3.0	ND	ND	ND
1,3-Dichlorobenzene	3.0	ND	ND	ND
1,4-Dichlorobenzene	3.0	ND	ND	ND
1,1-Dichloroethane	2.0	ND	ND	ND
1,2-Dichloroethane	2.0	ND	ND	ND
1,1-Dichloroethylene	2.0	ND	ND	ND
1,2-Trans Dichloroethylene	2.0	ND	ND	ND
1,2-Dichloropropane	2.0	ND	ND	ND
1,3-Trans Dichloropropane	6.0	ND	ND	ND
1,3-Cis Dichloropropane	2.0	ND	ND	ND
Ethyl Benzene	2.0	*	*	ND
Methylene Chloride	3.0	ND	17	27
1,1,2,2-Tetrachloroethane	2.0	ND	ND	ND
Tetrachloroethylene	4.0	ND	ND	ND
Toluene	2.0	25,000	104,000	ND
1,1,1-Trichloroethane	2.0	ND	ND	ND
1,1,2-Trichloroethane	2.0	ND	ND	ND
Trichloroethylene	2.0	82	ND	210
Trichlorofluoromethane	3.0	ND	100	ND
Vinyl Chloride	4.0	ND	ND	ND
Xylene	2.0	ND	ND	ND

ND - Not Detected (Less that Detection Limit)
* - Interference with analysis

concentration of the other detected volatile organics did not exceed 15 ug/g.

The depth to the zone of saturation generally varied between 8 and 15 feet in the vicinity of the West Ramp at the time of drilling. The only two soil samples which were obtained within the zone of saturation correspond to the two monitoring wells in which trichloroethylene was reported in the water samples (W-11 and W-14). In these instances the trichloroethylene concentrations in the water samples were 300 to 500 times less than the corresponding concentration in the saturated soil samples.

EP toxicity (metals) and ignitability tasks were performed on soil samples from the 2.5, 7.5 and 10.5 foot levels of boring W-11 and similar levels from boring W-15. The results of these analyses are presented in Appendix H and summarized on Table 4-17. These results indicate that these samples are non-hazardous. No other samples were taken for EP toxicity and ignitability testing at any other locations on the Base.

4.4.2 Soil Quality, Site No. 7, East Ramp

Undisturbed soil samples were obtained from the 7.5, 10.5 and 25 foot depth intervals in the borings installed in the vicinity of the East Ramp (W-1 through W-4). Unlike the sample intervals at the West Ramp, these intervals were selected to provide a representative distribution of contamination both above and within the zone of saturation. The soil samples were submitted for laboratory analysis of oil and grease and volatile organics.

The oil and grease concentrations range between 69 and 229 mg/kg. These concentrations increased with depth in samples from borings W-1 and W-2. In the samples from borings W-3 and W-4, the maximum oil and grease concentrations were detected in samples from the 15.5 foot interval.

Toluene, trichloroethylene, methylene chloride, 1,1,1- and 1,1,2-trichloroethane, trichlorofluromethane and chloroform were the most commonly reported volatile organic compounds in the soil samples from the East Ramp.

As with the West Ramp soil samples, trichloroethylene was detected in all of the soil samples from East Ramp. The trichloroethylene concentrations ranged between 107 and 6800 ug/g. The highest concentrations were reported in the 15.5 or 25 foot depth intervals. The depth to the zone of

TABLE 4-17

SUMMARY OF EPA TOXICITY AND IGNITABILITY RESULTS
SELFRIDGE AIR NATIIONAL GUARD BASE

Sample Sites
EP Toxicity Results

Parameter	Detection Limit	Hazard Limit[a]	W-11 2.5'	W-11 7.5'	W-11 10.5'	W-15 2.5'	W-15 7.5'	W-15 10.5'
	Units of Concentration ug/L							
Arsenic	10	5,000	ND	ND	ND	ND	ND	ND
Barium	20	10,000	170	440	1,250	340	120	510
Cadmium	50	1,000	ND	ND	ND	ND	ND	ND
Chromium	50	5,000	ND	ND	ND	ND	ND	ND
Mercury	500	200	ND	ND	ND	ND	ND	ND
Lead	0.5	5,000	ND	ND	ND	ND	ND	ND
Selenium	10	1,000	ND	11	ND	ND	ND	ND
Silver	100	5,000	ND	ND	ND	ND	ND	ND
			Ignitability Results					
Ignitability	—	—	NI	NI	NI	NI	NI	NI

[a] A sample is considered hazardous if the extract from that sample containing any of the listed parameters at concentrations equal to or greater than the hazard limit (40 CFR 261.24

ND - Not detectable

NI - The sample did not exhibit the characteristics of ignitability as defined in 40 CFR 201.21

saturation was 12 to 14 feet BLS at the East Ramp at the time of soil sampling. 1,1,1-trichloroethane was detected in at least one soil sample from each boring. The maximum concentrations of 1,1,1-trichloroethane (1900-2100 ug/g) were detected in a sample from boring W-1. Methylene chloride was also detected in samples from each boring with the highest levels reported in borings W-1 and W-3. Trichlorofluromethane was detected in all the samples from boring W-4 and in the 7.5 foot interval sample from boring W-2. The only other volatile organic concentrations of note were chloroform between 160 and 490 ug/g in the saturated zone samples from boring W-3.

4.5 QUALITY ASSURANCE ANALYSIS RESULTS

During the course of this investigation, several types of quality assurance samples were collected for analysis: field blanks and field duplicates, a trip blank, laboratory blanks, laboratory duplicates and laboratory spikes. Field blanks were collected by duplicating the sample collection procedure using commercial grade distilled water. Laboratory blanks and the trip blank were prepared in the laboratory using laboratory grade distilled/deionized water. The trip blank was carried, unopened, to the field and transported, unopened, back to the laboratory with the samples.

Laboratory blanks did not show detectable concentrations for any parameter (Tables 4-18, 4-19 and 4-20). The trip blank was analyzed only for volatile organics and there were no detectable levels found. The field blank also showed no detectable concentrations of volatile organic compounds.

Field blanks (W-42 and W-43, Pond C and Pond 4 on Table 4-18) did show detectable levels of non-VOA parameters. W-42 contained a dissolved copper concentration of 14 ug/l and petroleum hydrocarbon concentration of 0.10 mg/l. W-43 contained 1.8 mg/l TOC and 12 ug/l of dissolved copper. The surface water blanks both contained TOC above the detection limit. In addition, the surface water blank designated Pond 4 contained detectable concentrations of petroleum hydrocarbons and total phenolics. With the exception of the TOC concentration in W-43 and the total phenolic concentration in Pond 4, all other positive results were only slightly above the detection limit and well below the concentrations found when the parameters were identified in actual samples.

It is considered that the copper and total phenolic concentrations may have been introduced in the field; concentra-

Table 4-18
Summary of Quality Assurance
Sampling Results - Groundwater and Surfacewater
Selfridge - ANGB

Analyte (units)	Detection Limit	Lab Duplicates					Field Duplicates	
SITE		W-2	W-5	W-7	W-12	W-24	W-20A	W-41 (W-15)
Total Organic Carbon (mg/l)	0.5	NR	NR	NR	8.6	1.7k	38.5	11.6
Total Phenolics (ug/l)	5	NR	NR	NR	NR	NR	7	ND
Chemical Oxygen Demand (mg/l)	0.5	NR	NR	NR	NR	NR	NR	NR
Cadmium (ug/l)	10	NR	29	ND	NR	NR	NR	NR
Chromium (ug/l)	10	NR	ND	ND	NR	NR	NR	NR
Copper (ug/l)	10	NR	NR	34	NR	NR	NR	NR
Lead (ug/l)	10	NR	45	ND	NR	NR	NR	NR
Nickel (ug/l)	100	NR	ND	ND	NR	NR	NR	NR
Zinc (ug/l)	20	NR	NR	ND	NR	NR	NR	NR
Petroleum Hydrocarbon (mg/l)	0.1	NR	NR	NR	NR	NR	1.5	1.3
Oil and Grease (mg/l)	0.1	NR	NR	NR	NR	NR	NR	NR
pH (units)	NR	7.1	NR	NR	NR	NR	NR	7.2
S.P. Conductance (umhos/cm)	NR	537	2610	3770	NR	NR	NR	1020

ND - Not detected
NR - Not requested
k - Thousand

Table 4-18 (cont.)

Analyte (units)	Detection Limit	--Lab Blanks--	Field Blanks			
SITE			W-42	W-43	Pond C	Pond 4
Total Organic Carbon (mg/l)	0.5	ND	ND	1.8	0.7	0.6
Total Phenolics (ug/l)	5	ND	ND	ND	ND	51
Chemical Oxygen Demand (mg/l)	0.5	NR	ND	ND	NR	ND
Cadmium (ug/l)	10	NR	ND	ND	NR	ND
Chromium (ug/l)	10	NR	ND	ND	NR	ND
Copper (ug/l)	10	NR	14	12	NR	ND
Lead (ug/l)	10	NR	ND	ND	NR	ND
Nickel (ug/l)	100	NR	ND	ND	NR	ND
Zinc (ug/l)	20	NR	ND	ND	NR	ND
Petroleum Hydrocarbon (mg/l)	0.1	NR	0.1	ND	ND	0.11
Oil and Grease (mg/l)	0.1	NR	NR	NR	NR	NR
pH (units)	NR	NR	NR	NR	NR	NR
S.P. Conductance (umhos/cm)	NR	NR	NR	NR	NR	NR

ND - Not detected
NR - Not requested
k - Thousand

Table 4-19

Summary of Quality Assurance
VOA Sampling Results - Groundwater
Selfridge ANGB

Compounds / SITE	Detection Limit	Lab Duplicate W-15*	Field Blank *	Trip Blank *	Lab Blank *	Laboratory Spikes
Units of Concentration ug/L						
Benzene	4.0	ND	ND	ND	ND	98% Recovery
Bromoform	8.0	ND	ND	ND	ND	ND
Bromomethane	4.0	ND	ND	ND	ND	ND
Carbon Tetrachloride	2.0	ND	ND	ND	ND	ND
Chlorobenzene	2.0	ND	ND	ND	ND	ND
Chlorodibromomethane	2.0	ND	ND	ND	ND	ND
Chloroethane	2.0	ND	ND	ND	ND	93% Recovery
2-Chloroethylvinyl Ether	2.0	ND	ND	ND	ND	ND
Chloroform	2.0	ND	ND	ND	ND	ND
Chloromethane	4.0	ND	ND	ND	ND	ND
Dichlorobromomethane	2.0	ND	ND	ND	ND	ND
Dichlorodifluoromethane	4.0	ND	ND	ND	ND	ND
1,2-Dichlorobenzene	3.0	ND	ND	ND	ND	ND
1,3-Dichlorobenzene	3.0	ND	ND	ND	ND	ND
1,4-Dichlorobenzene	3.0	ND	ND	ND	ND	ND
1,1-Dichloroethane	2.0	ND	ND	ND	ND	91% Recovery
1,2-Dichloroethane	2.0	ND	ND	ND	ND	ND
1,1-Dichloroethylene	2.0	ND	ND	ND	ND	ND
1,2-Trans Dichloroethylene	2.0	ND	ND	ND	ND	84% Recovery
1,2-Dichloropropane	2.0	ND	ND	ND	ND	ND
1,3-Trans Dichloropropane	6.0	ND	ND	ND	ND	ND
1,3-Cis Dichloropropane	2.0	ND	ND	ND	ND	ND
Ethyl Benzene	2.0	ND	ND	ND	ND	100% Recovery
Methylene Chloride	3.0	ND	ND	ND	ND	ND
1,1,2,2-Tetrachloroethane	2.0	ND	ND	ND	ND	ND
Tetrachloroethylene	4.0	ND	ND	ND	ND	ND
Toluene	2.0	ND	ND	ND	ND	100% Recovery
1,1,1-Trichloroethane	2.0	ND	ND	ND	ND	ND
1,1,2-Trichloroethane	2.0	ND	ND	ND	ND	ND
Trichloroethylene	2.0	ND	ND	ND	ND	98% Recovery
Trichlorofluoromethane	3.0	ND	ND	ND	ND	ND
Vinyl Chloride	4.0	ND	ND	ND	ND	ND
Xylene	2.0	ND	ND	ND	ND	ND

ND - Not Detected (Less that Detection Limit)
* - Resample

Table 4-20
Summary of Quality Assurance
VOA - Soils
Selfridge ANGB

Volatile Compounds / SITE	Detection Limit	Lab Duplicates Method 602 only W-1,25'	Lab Duplicates Method 602 only W-13,10.5'	Lab Duplicates Method 601 only W-3,7.5'	Lab Duplicates Method 601 only W-11,2.5	Laboratory Spikes	Lab Blank
Units of Concentration ug/g							
Benzene	4.0	ND	ND	ND	ND	85% Recovery	ND
Bromoform	8.0	ND	ND	ND	ND	119% Recovery	ND
Bromomethane	4.0	ND	ND	ND	ND	ND	ND
Carbon Tetrachloride	2.0	ND	ND	ND	ND	ND	ND
Chlorobenzene	2.0	ND	ND	ND	ND	ND	ND
Chlorodibromomethane	2.0	ND	ND	ND	ND	ND	ND
Chloroethane	2.0	ND	ND	ND	ND	ND	ND
2-Chloroethylvinyl Ether	2.0	ND	ND	ND	ND	ND	ND
Chloroform	2.0	ND	ND	ND	ND	ND	ND
Chloromethane	4.0	ND	ND	ND	ND	ND	ND
Dichlorobromomethane	2.0	ND	ND	ND	ND	ND	ND
Dichlorodifluoromethane	4.0	ND	ND	ND	ND	125% Recovery	ND
1,2-Dichlorobenzene	3.0	ND	ND	ND	ND	ND	ND
1,3-Dichlorobenzene	3.0	ND	ND	ND	ND	ND	ND
1,4-Dichlorobenzene	3.0	ND	ND	ND	ND	ND	ND
1,1-Dichloroethane	2.0	ND	ND	ND	ND	ND	ND
1,2-Dichloroethane	2.0	ND	ND	ND	ND	ND	ND
1,1-Dichloroethylene	2.0	ND	ND	ND	ND	ND	ND
1,2-Trans Dichloroethylene	2.0	ND	ND	ND	ND	ND	ND
1,2-Dichloropropane	2.0	ND	ND	ND	ND	98% Recovery	ND
1,3-Trans Dichloropropane	6.0	ND	ND	ND	ND	ND	ND
1,3-Cis Dichloropropane	2.0	ND	ND	ND	ND	84% Recovery	ND
Ethyl Benzene	2.0	ND	ND	ND	ND	95% Recovery	ND
Methylene Chloride	3.0	ND	ND	ND	ND	ND	ND
1,1,2,2-Tetrachloroethane	2.0	ND	ND	ND	ND	ND	ND
Tetrachloroethylene	4.0	ND	ND	ND	ND	91% Recovery	ND
Toluene	2.0	ND	ND	ND	ND	85% Recovery	ND
1,1,1-Trichloroethane	2.0	ND	ND	ND	ND	ND	ND
1,1,2-Trichloroethane	2.0	ND	ND	ND	ND	ND	ND
Trichloroethylene	2.0	ND	ND	110	52	ND	ND
Trichlorofluoromethane	3.0	ND	ND	ND	ND	ND	ND
Vinyl Chloride	4.0	ND	ND	ND	ND	ND	ND
Xylene	2.0	ND	ND	ND	ND	ND	ND

ND - Not Detected (Less than Detection Limit)

tions of the other parameters are thought to have been in the water when it was purchased since the water was not laboratory, reagent grade.

Results of analysis of field and laboratory duplicates for water samples compare favorably with the analysis results of the original samples, in that the difference between the two sets of results is generally less than 10%. Results of analysis of laboratory duplicates of soil samples do not compare as well with results of analysis of the original samples. Greater variability is expected in soil samples because of the heterogeneous nature of the media.

4.6 SIGNIFICANCE OF FINDINGS

4.6.1 Water Quality - General

The principal objective of the Phase II Stage 1 Confirmation Study was to determine whether past hazardous waste operations or disposal practices have resulted in the environmental degradation. The results of the Phase II Stage 1 study represent two rounds of sampling at selected surface water sites and newly installed monitoring wells and selected contaminant indicators. The conclusions drawn from this information should be evaluated within this context.

Appendix I contains a complete listing of Federal and State drinking water and human health standards, criteria and guidelines applicable in the State of Michigan.

On November 28, 1980, the U.S. Environmental Protection Agency issued criteria for 64 toxic pollutants or pollutant categories which could be found in surface waters. The criteria established recommended maximum concentrations for acute and chronic exposure to these pollutants by both humans and aquatic life. The derivation of these exposure values was based upon cancer risk, toxic properties, and organoleptic properties.

The limits set for the cancer risk are not based upon a safe level for carcinogens in waters. The criteria state that for maximum protection for human health, the concentration should be zero. However, where this cannot be achieved, a range of concentrations corresponding to incremental cancer risks of from 1 in 10 million to 1 in 100,000 was presented (10^{-7} to 10^{-5}).

Toxic limits were established at levels for which no adverse effects would be produced. These are the health related

limits which have been used in this report to evaluate potential impacts. It should be noted that the cancer risk column is based upon one cancer case in one million, (10^{-6}). The EPA's evaluation criteria under CERCLA (Annex XIII) for selecting contaminant levels to protect public health call for the remedial actions to "attain levels of contamination which represent an incremental risk of contracting cancer between 10^{-5} and 10^{-6}." The 10^{-6} value was used to achieve the maximum protection to the public.

In addition to the cancer risk assessment criteria, the U.S.EPA Office of Drinking Water provides advice on health effects upon request, concerning unregulated contaminants found in drinking water supplies. This information suggests the level of a contaminant in drinking water at which adverse health effects would not be anticipated with a margin of safety; it is called a SNARL (Suggested No Adverse Response Level). Normally, values are provided for one-day, 10-day and longer-term exposure periods where available data exists. A SNARL does not condone the presence of a contaminant in drinking water, but rather provides useful information to assist in the setting of control priorities in cases when they have been found.

SNARLs are not legally enforceable standards. They are not issued as an official regulation, and they may or may not lead ultimately to the issuance of a national standard or Maximum Contamination Level (MCL). The latter must take into account occurrence and relative source contribution factors, in addition to health effects. The concentration set for SNARL purposes might differ from an eventual MCL. The SNARLs may also change as additional information becomes available. In short, SNARLs are offered as advice to assist those who are dealing with specific contamination situations to protect public health.

On 12 June 1984, the U.S. Environmental Protection Agency published a set of proposed rules under the Safe Drinking Water Act that would establish Recommended Maximum Contaminant Levels (RMCLs) for the following volatile organic chemicals (VOC's) in drinking water: trichloroethylene; tetrachloroethylene, carbon tetrachloride; 1,1,1-trichloroethane; vinyl chloride; 1,2-dichloroethane; benzene; 1,1-dichloroethylene; and p-dichlorobenzene. RMCLs are nonenforceable health goals which are to be set at levels which would result in no known or anticipated adverse health effects with an adequate margin of safety. This proposal is the initial stage of rulemaking for the establishment of

primary drinking water regulations for the VOCs. On 13 November 1985, the U.S.EPA published the proposed Maximum Containment Levels (MCLs) for the volatile organic compounds listed above, as well as proposed RMCLs for 17 synthetic organic compounds, 11 inorganic chemicals and four microbial contaminants (see Appendix I for listing). MCLs are enforceable standards and are to be set as close to the RMCLs as is feasible and are based upon health, treatment technologies, cost and other factors. The MCLs are based upon treatment technologies, costs and other feasibility factors.

The Michigan Department of Health has adopted the federal drinking water standards as the state groundwater quality standards. The local background groundwater quality serves as the non-degradation standard for all usable aquifers. Concentrations of man-made chemical compounds above the detection limit are considered to be in excess of background. Any area or portion of an aquifer with chemical concentrations in excess of background is classified as a "site of environmental contamination". Each site of environmental contamination is evaluated by the Michigan Department of Natural Resources and assigned a priority ranking on the state action list. The criteria for prioritizing and allocating investigation funds to a site are set forth in Section 307 of the Michigan Compiled Laws and the appurtenant rules and regulations. Remedial compliance levels are negotiated on a site by site basis. In those situations where removals are required, compliance levels are based upon risk factors; removal actions must continue until such a point that further removal does not effectuate a significant reduction in the risk factor. Discharges into groundwater of materials, related to present or past activities, at concentrations that exceed the maximum contaminant levels specified in the National Interim Primary Drinking Water Regulations are prohibited.

4.6.2 Water Quality at Selfridge ANGB

The applicable standards and criteria for potential contaminants and contaminant indicators of concern at Selfridge ANGB are summarized in Table 4-21 with additional reference materials included in Appendix I. For the contaminants of concern at Selfridge ANGB enforceable standards currently exist only for cadmium, copper, lead and zinc.

Concentrations of phenol in excess of the Federal Water Quality Criteria for Domestic Water Supplies were detected

TABLE 4-21

APPLICABLE STANDARDS, GUIDELINES AND CRITERIA
FOR
CONTAMINATION INDICATORS OF CONCERN AT SELFRIDGE ANGB

Detected Parameters	Water Quality Standards or Criteria*	Reference
TOC	None	General Contaminant Indicator
COD	None	General Contaminant Indicator
Phenol	1 ug/L	Federal Water Quality Criteria Domestic Water Supply
Oil and Grease	"virtually free"	Federal Water Quality Criteria Domestic Water Supply
Petroleum Hydrocarbon	"virtually free"	Federal Water Quality Criteria Domestic Water Supply
Cadmium	10 ug/L	Federal and State Drinking Water Standard
	5 ug/L	Federal Proposed Recommended Maximum Contamination Level
Copper	1 mg/L	Federal and State Drinking Water Standard
	1.3 mg/L	Federal Proposed Recommended Maximum Contamination Level
Lead	50 ug/L	Federal and State Drinking Water Standard
	20 ug/L	Federal Proposed Recommended Maximum Contamination Level

Table 4-21
(Con't)

Detected Parameters	Water Quality Standards or Criteria*	Reference
Zinc	5 mg/L	Federal and State Drinking Water Standard
Methylene Chloride	None	
Trichloroethylene	0.005 mg/L	Federal Proposed Maximum Contaminant Level
1,2 trans Dichloroethylene	70 ug/L	Federal Proposed Recommended Maximum Contamination Level
Toluene	2000 ug/L	Federal Proposed Recommended Maximum Contamination Level
Benzene	1.0 ug/L	Federal Proposed Maximum Contaminant Level
Vinyl Chloride	5.0 ug/L	Federal Proposed Maximum Contaminant Level
Ethyl Benzene	680 ug/L	Federal Proposed Recommended Maximum Contamination Level
Chloroform	0.19 ug/L	10^{-6} Cancer Risk Federal Register, November 28, 1980
1,2-Dichlorobenzene	620 ug/L	Federal Proposed Recommended Maximum Contamination Level

*See Appendix I for a discussion of these criteria.

in sixteen of the twenty-four phenol samples including both fire training areas and all the landfills.

Oil and grease concentrations were reported in excess of the detectable concentrations in 10 of the 11 samples submitted for analysis. Petroleum hydrocarbon concentrations were reported in excess of 300 ug/L in all nineteen of the samples submitted for analysis. The Federal Water Quality Criteria suggests that domestic water supplies be virtually free of these constituents.

Concentrations of soluble copper were detected in excess of the Federal Primary Drinking Water Standard of 1 mg/L in four of thirteen samples submitted for laboratory analysis. At least one of these samples was from each of three landfills.

Soluble cadmium was detected in only one sample, however this concentration was in excess of the Federal Primary Drinking Water Standard of 10 ug/L.

The VOC concentration in two water samples from two sites (East Ramp and Southwest Landfill) are in excess of the recently proposed Federal Maximum Containment Level. Standards have not been established for volatile organic concentration in soils. The VOC's of primary concern are trichloroethylene, 1.2-Trans Dichloroethylene and vinyl chloride.

The TOC and/or COD levels reported from the samples submitted for analysis suggest that "statistically significant" contamination has probably occurred at each of the seven investigation sites.

4.6.3 Soil Quality at Selfridge ANGB

Detectable concentrations of oil and grease and VOC's were reported in the soil samples from each of the borings at the East and West Ramps. The most notable of these concentrations are the extremely high levels of toluene and oil and grease (presumably petroleum hydrocarbon) in the soils near the site of the January 1984 fuel spill on the West Ramp and the seemingly universal presence of trichloroethylene and methylene chloride.

4.7 Conclusions

Based on the results of the Phase II Stage 1 Study at the Selfridge Air National Guard Base, the following key conclusions have been drawn.

4.7.1 Hydrogeology

1. A confined or semi-confined aquifer occurs within 15 feet of the land surface beneath the Selfridge ANGB. This aquifer occurs within Pleistocene-age unconsolidated sediments of glacial, lacustrine and fluvial origin.

2. The aquifer(s) within the unconsolidated sediments is the only significant source of potable groundwater in the Macomb County area. Typical yields from wells completed within these sediments are generally less than 10 gallons per minute. The production zones are generally relatively thin layers of sand and gravel occurring at depths greater than 25 feet.

3. At the time of monitoring well installation saturated materials were generally encountered at depths of 8 to 14 feet BLS. The static water levels in all of the base monitoring wells stabilized within five feet of the land surface.

4. An analysis of the existing well records suggests that the artesian or confining pressure increases approximately 0.8 of a foot per foot of depth.

5. Groundwater in the upper portions of the unconsolidated sediments generally flows towards, and discharges to, either Lake St. Clair or the Clinton River. Local variations in the direction of groundwater flow may be induced by backfilled excavations and local topographic depressions.

6. The impermeable nature and thickness (35-50 feet) of the lacustrine clays at or near the land surface of the Base significantly minimize the potential for vertical migration of contaminants to deeper (>50 feet) water-bearing units. Therefore the interaction between shallow and deeper water bearing zones need not be a focus of future studies performed at the Base.

4.7.2 Water Quality

1. The concentrations of soluble copper at each of the landfills and soluble cadmium at the Southwest Landfill are the only contaminants which were detected in excess of enforceable water quality standards.

2. The soils and groundwater beneath and adjacent to the East and West Ramps exhibit moderate to high levels of contamination. The analytical results suggest that the contaminants are those generally associated with fuel handling and storage and solvent degreasing operations. The latter activity has not been previously documented as a common operation on the ramps.

3. The elevated concentrations of TOC, COD, phenols, petroleum hydrocarbon, soluble copper and cadmium, and VOC's in the western portion of the Southwest Landfill are indicative of a source of contamination in this area. The analyses of surface water samples from this site suggest that leachate from this landfill is degrading the quality of the adjacent surface waters. It is presumed that these surface waters are eventually discharged to the Clinton River.

4. The elevated TOC, phenol and petroleum hydrocarbon concentrations in the water samples from Fire Training Area-2 indicate that the aquifer beneath this facility has been contaminated. The low permeability clays underlying this site have probably prevented severe subsurface contamination at this site.

5. Subsurface contamination exists beneath and adjacent to the Northwest and Tucker Creek Landfills and Fire Training Area-1. The existing water quality information at these sites is not sufficient to determine the nature, extent or severity of contamination.

6. The elevated COD levels in the monitoring wells around the Base landfills suggest that the anaerobic conditions requisite for methane generation are present at each of these sites. The existing site-specific information is not adequate to assess the potential for methane accumulation at these facilities.

7. It is suspected, on the basis of contamination in the upgradient well at Tucker Creek Landfill, that concentrations of metal and organic compounds may have been incorporated in the runoff from the ramps, runways and industrial operation areas, and as a result may have become concentrated in the soils and groundwater near the drainage system catch basins.

8. Based on the results of the Phase II Stage 1 Investigation the revised site priority ranking is as follows:

    1-Southwest Sanitary Landfill
    2-West Ramp
    3-East Ramp
    4-Fire Training Area-2
    5-Tucker Creek Landfill
    6-Northwest Landfill
    7-Fire Training Area-1

4.7.3 Categorization of Investigation Sites

As a conclusion to the investigation, each of the sites investigated can be categorized according to whether it requires no further action (Category 1), requires further investigation (Category II), or is ready for remedial action (Category III). Sites may be subsequently recategorized at the end of each successive stage of the Phase II Investigation until a determination is made if, and what type of remedial action (Phase IV) is warranted. Commonly, most sites fall into Category II at the end of the Phase II Stage 1 investigation. The following definitions have been used in the classification of investigation sites at Selfridge ANGB:

- Category I applies to sites where no further action (including remedial action) is required because sufficient data exist to rule out unacceptable health or environmental risks resulting from the site.

- Category II applies to sites requiring further investigation to complete the Stage 1 Confirmation Study and/or the Stage 2 Quantification Study.

- Category III applies to sites where remedial action is required and all necessary data to support a feasibility study of remedial alternatives has been gathered. These sites are ready

for IRP Phase III (Technology Base Development) or Phase IV (Remedial Action).

Site-by-site conclusions are summarized in Table 4-22, which lists a category for each site, presents the rationale for that categorization, and references the report subsections that present supporting evidence for that categorization. Investigation alternatives for each category are reviewed in Section 5, and site-specific recommendations are presented in Section 6.

Table 4 - 22
Summary of Site Classification
Selfridge Air National Guard Base
IRP Phase II Stage 1

Site Number and Reference	Stage II Investigation Category	Rationale	Supporting Subsection
1 - Southwest Landfill	II	Organic and soluble metal contamination in shallow aquifer with high potential to migrate to a Great Lakes tributary; further investigation acquired to define magnitude, extent and nature of contamination and evaluate migration pathways.	4.2 4.3.1 4.5.2 4.6
2 - Fire Training Area - 2	II	Hydrocarbon contamination in shallow aquifer of limited extent; further investigation required to define magnitude, extent and nature of contaminants.	4.2 4.3.2 4.5.2 4.6
3 - Fire Training Area - 1	II	Localized hydrocarbon contamination of shallow aquifer. No unacceptable health or environmental risks at current levels.	4.2 4.3.3 4.5.2 4.6
4 - West Ramp	II	Extensive organic contamination of a shallow aquifer and soil profile. Further investigation acquired to define magnitude, extent and nature of contamination.	4.2 4.3.4 4.4.1 4.5.2 4.6

Table 4-22(cont.)

Site Number and Reference	Stage II Investigation Category	Rationale	Supporting Subsection
5 - Tucker Creek Landfill	II	Organic and soluble metal contamination in shallow aquifer adjacent to a Great Lake waterway; further investigation required to define extent, magnitude nature and source of contamination and assess potential for off-site migration.	4.2 4.3.5 4.5.2 4.6
6 - Northwest Landfill	II	Organic and soluble metal contamination in shallow aquifer; further investigation required to define magnitude, extent and nature of contamination and assess potential for impact from West Ramp sources.	4.2 4.3.6 4.5.2 4.6
7 - East Ramp	II	Extensive organic contamination of shallow aquifer and soil profile; further investigation required to define magnitude, extent and nature of contamination.	4.2 4.3.7 4.4.2 4.5.2 4.6

SECTION 5

ALTERNATIVE MEASURES

5.1 GENERAL

The principal goal of the Phase II Stage 1 Confirmation Study at the Selfridge ANGB was to assess whether environmental degradation had occurred as a result of past material handling and disposal practices at the Base. The results presented in Section 4 confirm that the Base water quality has been slightly to highly impacted by operations at each of the sites. Further verification and quantification are warranted at each of the investigation sites. A general description of the investigation alternatives is presented in Section 5. The specific recommendations are described in Section 6.

The alternative measures presented in Section 5 focus on the problem definition of the environmental quality situation at Selfridge ANGB. The results of the problem definition studies will provide the necessary input for the future evaluation of remedial alternatives. The problem definition alternatives and associated rationale are summarized on Table 5-1.

These alternative measures are discussed site-by-site in the following sections. Based on these possible alternative actions, specific implementation recommendations are presented in Section 6.

5.1.1 Alternative Measures, Site No. 1, Southwest Sanitary Landfill

The water quality monitoring results from the Southwest Sanitary Landfill have indicated the presence of elevated TOC, volatile organic, COD, phenol, oil and grease and soluble metal concentrations in the ground and surface water beneath and adjacent to the site. The highest concentrations are in the western portion of the site. The potential toxicity of these concentrations and the proximity of a potentially sensitive aquatic habitat necessitates further characterization of the contaminants and quantification of the potential migration pathways. This characterization effort should involve the installation of additional monitoring wells within and around the western and southern

TABLE 5.1

SUMMARY OF PROBLEM DEFINITION ALTERNATIVE MEASURES

Alternative Action	Site(s)	Associated Rationale
1. Expansion of Monitoring Well Network	1-Southwest Sanitary Landfill 4-West Ramp 5-Tucker Creek Landfill 6-Northwest Landfill 7-East Ramp	Further define the extent of subsurface contamination and the configuration of the potentiometric surface.
2. Expansion of Water Quality Testing Program	All Sites	Characterize the contaminant species and assess the hazard potential.
3. Soil Sampling and Analysis	1-Southwest Sanitary Landfill 2-Fire Training Area-2 3-Fire Training Area-1 4-West Ramp 5-Tucker Creek Landfill 7-East Ramp	Define the extent and magnitude of soil matrix contamination.
4. Estimation of Hydraulic Properties of Subsurface Materials	1-Southwest Sanitary Landfill 2-Fire Training Area-2 4-West Ramp 5-Tucker Creek Landfill 6-Northwest Landfill 7-East Ramp	Estimate groundwater velocity and quantify potential for subsurface migration.
5. Sampling and Analysis of Subsurface Storm Drainage Waters	1-Southwest Sanitary Landfill 2-Fire Training Area-2 4-West Ramp 5-Tucker Creek Landfill 6-Northwest Landfill 7-East Ramp	Assess potential contaminant transport interaction between groundwater and storm water drainage system.
6. Evaluation of Soil Partitioning Characteristics	4-West Ramp 7-East Ramp	Estimate attenuation capacity of soils in known areas of contamination.

TABLE 5-1
(Cont')

Alternative Action	Site(s)	Associated Rationale
7. Establish Continuous Groundwater Level and Storm Monitoring Stations	4-West Ramp 7-East Ramp	Quantity seasonal variations in hydraulic head and interaction of ground and surface waters.

perimeter of the landfill to define the extent of contamination. Continuous soil sampling methods should be utilized during the installation of these wells to obtain representative soil samples and further define the variability of the subsurface stratigraphy. Water samples should be obtained from the all existing sampling points to confirm and further define the extent and magnitude of contamination. Consideration should also be given to sampling the buried storm drain whicn traverses the western portion of the site to evaluate if contaminants are migrating through the storm sewer to the Clinton River. Because the type and nature of the materials deposited at this site are largely undocumented, the soil and water analyte suite should be expanded to include all Priority Pollutant compounds as well as landfill leachate parameters and petroleum hydrocarbon. Piezometer tests should be performed on all monitoring wells to estimate the hydraulic conductivity of the subsurface materials and assess the potential for contaminant migration.

5.1.2 Alternative Measures, Site No. 2
Fire Training Area -2

The results of the water quality analyses from Fire Training Area-2 indicate that the groundwater beneath this site has been contaminated by uncombusted fuel products and fire retardant agents. The nature and extent of this contamination cannot be adequately evaluated with the existing information. Soil borings should be installed within the burn pit using continuous sampling methods to obtain representative soil samples and further define the subsurface stratigraphy. Water samples should be obtained from the storm drain which runs south of the site to assess potential interaction between contaminated groundwater and the storm drainage system. An additional set of groundwater samples should also be obtained to confirm and further define the magnitude of contamination. The soil and water analyses should be expanded to include EP Toxicity (lead), Priority Pollutant organics, and petroleum hydrocarbon. Piezometer tests should be performed on all existing monitoring wells to estimate the hydraulic conductivity of the subsurface materials, and the potential for contaminant migration.

Monitoring well W-20 should either be restored to it's original condition or grouted and replaced.

5.1.3 Alternative Measures, Site No. 3 Fire Training Area - 1

The water quality monitoring results from Site No. 3 indicate that the water quality beneath this facility has been slightly to moderately impacted by past training activities. Additional investigation activities should be considered to define the extent and magnitude of subsurface contamination at this site. Soil borings should be installed within and around the site to obtain representative soil samples and to further define the subsurface stratigraphy. An additional set of groundwater samples should be obtained to verify the Stage 1 results. To more accurately define the severity of the contamination, the soil and water quality analyte suite should be expanded to include, Priority Pollutant organics and petroleum hydrocarbon. Soil samples should be analyzed for lead, using EP Toxicity; water samples should be analyzed for soluble lead.

5.1.4 Alternative Measures, Site No. 4, West Ramp

The soil and water quality testing results from the West Ramp suggest extensive subsurface contamination by petroleum hydrocarbons and organic solvents. Additional site investigation activities should be considered to confirm these results, further define the extent and magnitude of contamination and evaluate its potential for migration.

Additional wells and soil borings should be installed to evaluate the extent of contamination. In addition to sampling of all monitoring wells, samples should be obtained from the West Ramp storm drains to assess potential interaction of contaminated groundwater and the storm drainage system. To evaluate magnitude of contamination, the soil and water analytical protocol should be expanded to include soluble lead, petroleum hydrocarbon and Priority Pollutant organics.

Piezometer tests should be performed on the monitoring wells to evaluate the hydraulic conductivity of the saturated materials beneath and adjacent to the West Ramp. The establishment of continuous groundwater level and storm drain recording stations adjacent to the northeast corner of the West Ramp should be considered to evaluate the correlation between precipitation events, subdrainage flow and the groundwater level fluctuations. Soil samples should also be submitted for laboratory analysis of total organic matter to estimate the attenuation capacity of the surficial soils near the West Ramp.

5.1.5 Alternative Measures, Site No. 5 Tucker Creek Landfill

The results of the water quality analyses of samples from the Tucker Creek Landfill indicate that the groundwater adjacent to this site has been contaminated by landfill leachate and/or undefined upgradient sources. Additional investigations should be conducted to define the extent, magnitude and source(s) of contamination and the potential for discharge of contaminated groundwater to Lake St. Clair. Additional monitoring wells should be installed within and around the northern and eastern perimeter of the landfill to define the extent of contamination. Soil borings should be installed near the catch basins of the storm drainage system in the immediate vicinity of Tucker Creek Landfill to assess potential contamination from upstream sources. Water samples should also be collected from the storm drainage system to evaluate the potential for mixing of runoff waters and contaminated groundwater. Consideration should be given to expanding the soil and water sampling protocols to include Priority Pollutant compounds and landfill leachate parameters. Piezometer tests should be performed on all monitoring wells to evaluate the hydraulic conductivity of the saturated subsurface materials and the potential for contaminant migration.

5.1.6 Alternative Measures, Site No. 6, Northwest Landfill

The water quality monitoring results from the Northwest Landfill indicate that the shallow water bearing zone has been contaminated by landfill leachate. The hazard posed by this contamination cannot be adequately assessed from the existing information. Additional monitoring wells should be installed within and adjacent to the northern and southern perimeter of the landfill to define the extent of contamination. Water samples should be collected from the buried storm drains along the southern and southeastern perimeter of the landfill to evaluate the potential for interaction between runoff waters and contaminated groundwater. The water quality analyte suite should be expanded to include all Priority Pollutant compounds and landfill leachate parameters. Piezometer tests should be performed on each of the monitoring wells to assess the hydraulic characteristics of the saturated subsurface materials and the potential for contaminant migration.

5.1.7 Alternative Measures, Site No. 7, East Ramp

The soil and water quality analyses from the East Ramp suggest extensive subsurface contamination has occurred adjacent to this facility. Additional investigations should be considered to confirm these results and further define the extent and magnitude of contamination and the pathways for potential contaminant migration. These investigations should include the installation of additional monitoring wells and soil borings, adjacent to the ramp to define the extent and magnitude of contamination. Water samples should be obtained from the storm drains beneath the East Ramp to assess the potential interaction of contaminated groundwater and surface runoff. The soil and water sampling protocol should be expanded to include soluble lead, petroleum hydrocarbon, and Priority Pollutant organics. In addition selected soil samples should be submitted for quantification of total organic matter to assess the partitioning, coefficient of the East Ramp soils. Piezometer tests should be performed on all monitoring wells to evaluate the hydraulic conductivity of the saturated materials beneath and adjacent to the East Ramp. Consideration should be given to establishing continuous groundwater level and storm drain stage recording stations adjacent to the southwest corner of the ramp to evaluate the correlation between precipitation events, storm drainage flow and groundwater level fluctuations.

SECTION 6

RECOMMENDATIONS

6.1 GENERAL

The findings of the Phase II Stage 1 Confirmation Study at the Selfridge ANGB indicate the need for follow-up investigation which should focus on:

1. Expansion of the monitoring and sampling program which will emphasize evaluation of the nature and extent of contamination by Priority Pollutant and petroleum hydrocarbon compounds.

2. Evaluation of the potential contaminant pathways.

The specific recommendations for further investigation actions at each site are presented in the following subsections. Recommendations for specific remedial actions, including the establishment of a long-term monitoring program, will be provided in the Phase II Stage 2 report.

6.1.1 Recommendations, Site No. 1 Southwest Sanitary Landfill

The following additional work is recommended for the Southwest Sanitary Landfill:

1. One monitor well nest should be installed within and three additional well nests should be installed around the western and southern perimeter of the landfill. Each well point shall be completed with 10 feet of screen. The screen of the upper well point shall extend from 2-4 feet above, to 6-8 feet below the water table. However, there must be at least a two foot seal above this screen. Therefore, the top of the screen will be no closer to the ground surface than 2 feet. The lower screen shall extend from approximately 15 to 25 feet below the land surface. The actual placement of the screens shall be determined in the field by the on-site geologist on the basis of stratigraphic criteria. The deepest well point of each nest shall be drilled first to a depth of 25 to 30 feet with continuous soil sampling methods to facilitate the definition of site stratigraphy and the collection of representative soil samples. One

soil sample shall be collected from each well-nest location and submitted for laboratory analysis of petroleum hydrocarbon, and U.S. Priority Pollutant Compounds.

2. Storm water runoff sampling stations should be established at the manhole ports north of the landfill and near the West Pump House (Building 507). The invert elevation of the storm drain at these points should be established by survey or by inspection of existing engineering records.

3. Two rounds of samples should be obtained from the previous sampled impoundments and the storm water sampling stations. One round should be obtained immediately after an above-freezing precipitation event; the remaining round should be obtained after a dry period of substantial duration. One round of groundwater samples should be obtained from all pre-existing and additional monitoring wells.

4. All water samples should be analyzed for petroleum hydrocarbon, U.S.EPA Priority Pollutant compounds, landfill leachate parameters (nitrate, iron, ammonia-nitrogen, boron), TOC, and COD.

5. Slug tests should be performed on all existing and additional monitoring wells to estimate the hydraulic conductivity of the saturated materials beneath and adjacent to the landfill. The volume displacement method should be utilized to perform these tasks.

6. A continuous groundwater level recorder should be installed near the northern edge of the Southwest Landfill. The data from this recorder shall be compared with data from similar instruments installed at the West and East Ramps to evaluate ground water fluctuation pattern.

6.1.2 Recommendations, Site No. 2, Fire Training Area-2

The following additional work is recommended for Fire Training Area-2:

1. Install three soil borings within the training burn area. These borings should be drilled to a depth of 25-30 feet, with continuous soil sampling methods to facilitate the definition of site

stratigraphy and the collection of representative soil samples. Three representative soil samples should be collected at various depths from each boring for laboratory analysis of petroleum hydrocarbon, U.S.EPA Priority Pollutant organics and EP Toxicity (lead). These borings shall be grouted with a cement-bentonite mixture subsequent to sampling.

2. Storm water sampling stations should be established at the manhole ports east and west of the site. The invert elevation of the storm drain at these points should be established by survey or by inspection of existing engineering records.

3. Two rounds of samples should be obtained from the previous sampled impoundments and the storm water sampling stations. One round should be obtained immediately after an above-freezing precipitation event; the remaining round should be obtained after a dry period of substantial duration.

4. All water samples should be analyzed for petroleum hydrocarbon, U.S.EPA Priority Pollutant organics, soluble lead, and TOC.

5. Slug tests should be performed on all existing and additional monitoring wells to estimate the hydraulic conductivity of the saturated materials beneath and adjacent to the training site. The volume displacement method should be utilized to perform these tests.

6.1.3 Recommendations, Site No. 3, Fire Training Area-1

The following additional work is recommended for Fire Training Area-1:

1. Three soil borings should be drilled within Fire Training Area-1. These borings should be installed to a depth of 25-30 feet, with continuous soil sampling methods to facilitate the definition of site stratigraphy and the collection of representative soil samples. Three samples from various depths in each of these borings should be submitted for laboratory analysis of petroleum hydrocarbons, U.S.EPA Priority Pollutants and EP Toxicity (lead). These borings should be grouted

with a cement-bentonite mixture subsequent to sampling.

2. A single set of water samples should be obtained from the existing wells and submitted for laboratory analysis of petroleum hydrocarbon and U.S. EPA Priority Pollutants.

6.1.4 Recommendations, Site No. 4, West Ramp

The following additional work is recommended for the West Ramp:

1. Four monitor well nests should be drilled around the entire perimeter of the West Ramp. Each well point shall be completed with 10 feet of screen. The screen of the upper well point shall extend from 2-4 feet above, to 6-8 feet below the water table. However, there must be at least a two foot seal above this screen. Therefore, the top of the screen will be no closer to the ground surface than 2 feet. The lower screen shall extend from approximately 15 to 25 feet below the land surface. The actual placement of the screens shall be determined in the field by the on-site geologist on the basis of stratigraphic criteria. The deepest well point of each nest shall be drilled first to a depth of 25 to 30 feet with continuous soil sampling methods to facilitate the definition of site stratigraphy and the collection of representative soil samples. One soil sample shall be collected from each well-nest location and submitted for laboratory analysis of petroleum hydrocarbon, and U.S. Priority Pollutant compounds.

2. Soil borings should be drilled adjacent to each of the ten storm drainage catch basins around the perimeter of the West Ramp. These borings should also be drilled to a depth of 25-30 feet with continuous soil sampling methods.

3. Ten composite soil samples should be obtained from each of the catch basin borings and submitted for laboratory analysis of petroleum hydrocarbon, U.S. EPA Priority Pollutant organics and EP Toxicity (lead). The rationale for compositing these samples shall be on the basis of organic vapor analyzer results obtained in the field.

4. Storm water sampling stations should be established at four manhole points around the western and eastern perimeter of the West Ramp. The invert elevation of the storm drain at these points should be established by survey or by inspection of existing engineering records.

5. Two rounds of samples should be obtained from the storm water sampling stations. One round should be obtained immediately after an above-freezing precipitation event; the remaining round should be obtained after a dry period of substantial duration. One round of groundwater samples should be obtained from all existing and additional monitoring wells.

6. All water samples should be analyzed for petroleum hydrocarbon, U.S.EPA Priority Pollutant compounds, soluble lead and TOC.

7. Slug tests should be performed on all existing and additional monitoring wells to estimate the hydraulic conductivity of the saturated materials beneath and adjacent to the landfill. The volume displacement method should be utilized to perform these tests.

8. At least five representative soil samples should be collected from the West Ramp soil borings and submitted for laboratory analysis of total organic matter. This information should then be utilized to estimate partitioning coefficients for individual contaminant species.

9. A continuous groundwater level recorder should be installed at the northeast corner of the West Ramp. A similar recording device should also be installed in a nearby storm drain. The data from these installations should be combined with local precipitation data and analyzed to evaluate the correlation between precipitation, subdrainage flow and groundwater fluctuations.

6.1.5 Recommendations, Site No. 5, Tucker Creek Landfill

The following additional work is recommended for the Tucker Creek Landfill:

1. Three monitor well nests should be installed around the eastern and northern perimeter of the fill

area. Each well point shall be completed with 10 feet of screen. The screen of the upper well point shall extend from 2-4 feet above, to 6-8 feet below the water table. However, there must be at least a two foot seal above this screen. Therefore, the top of the screen will be no closer to the ground surface than 2 feet. The lower screen shall extend from approximately 15 to 25 feet below the land surface. The actual placement of the screens shall be determined in the field by the on-site geologist on the basis of stratigraphic criteria. The deepest well point of each nest shall be drilled first to a depth of 25 to 30 feet with continuous soil sampling methods to facilitate the definition of site stratigraphy and the collection of representative soil samples. One soil sample shall be collected from each well-nest location and submitted for laboratory analysis of petroleum hydrocarbon, and U.S. Priority Pollutant compounds.

2. Soil borings should be installed adjacent to each of the eight storm drainage catch basins in the immediate vicinity of the Tucker Creek Landfill. These borings should be drilled to a depth of 25-30 feet with continuous soil sampling methods.

3. Composite soil samples should be obtained from each of the catch basin borings and submitted for laboratory analysis of petroleum hydrocarbon, U.S.EPA Priority Pollutant compounds and E.P. Toxicity. The rationale for the compositing of these samples shall be on the basis of organic vapor analyzer results obtained in the field.

4. Storm water sampling stations should be established at five manhole points in the vicinity of the landfill. The invert elevation of the storm drain at these points should be established by survey or by inspection of existing engineering records.

5. Two rounds of samples should be obtained from the storm water sampling stations. One round should be obtained immediately after an above-freezing precipitation event; the remaining round should be obtained after a dry period of substantial duration. One round of groundwater samples should be

obtained from all existing and additional monitoring wells.

6. All water samples should be submitted for laboratory analysis of U.S.EPA Priority Pollutant compounds, landfill leachate parameters (nitrate, iron, ammonia-nitrogen, boron), TOC and COD.

7. Slug tests should be performed on all existing and additional monitoring wells to estimate the hydraulic conductivity of the saturated materials beneath and adjacent to the landfill. The volume displacement method should be utilized to perform these tests.

6.1.6 Recommendations, Site No. 6, Northwest Landfill

The following additional work is recommended for the Northwest Landfill:

1. Two monitor well nests should be installed around the eastern and northern perimeter of the fill area. Each well point shall be completed with 10 feet of screen. The screen of the upper well point shall extend from 2-4 feet above, to 6-8 feet below the water table. However, there must be at least a two foot seal above this screen. Therefore, the top of the screen will be no closer to the ground surface than 2 feet. The lower screen shall extend from approximately 15 to 25 feet below the land surface. The actual placement of the screens shall be determined in the field by the on-site geologist on the basis of stratigraphic criteria. The deepest well point of each nest shall be drilled first to a depth of 25 to 30 feet with continuous soil sampling methods to facilitate the definition of site stratigraphy and the collection of representative soil samples. One soil sample shall be collected from each well-nest location and submitted for laboratory analysis of petroleum hydrocarbon, and U.S. Priority Pollutant compounds.

2. Storm water sampling stations should be established at two manhole ports southwest of the landfill. The invert elevations of the storm drain at these points should be established by survey or by inspection of existing engineering records.

3. Two rounds of samples should be obtained from the storm water sampling stations. One round should be obtained immediately after an above-freezing precipitation event; the remaining round should be obtained after a dry period of substantial duration. One round of groundwater samples should be obtained from all existing and additional monitoring wells.

4. All water samples should be submitted for laboratory analysis of U.S.EPA Priority Pollutant compounds, landfill leachate parameters (nitrate, iron, ammonia-nitrogen, boron), TOC and COD.

5. Slug tests should be performed on all existing and additional monitoring wells to estimate the hydraulic conductivity of the saturated materials beneath and adjacent to the landfill. The volume displacement method should be utilized to perform these tests.

6.1.7 Recommendations, Site No. 7, East Ramp

The following additional work is recommended for the East Ramp:

1. Four monitor well nests should be installed around the entire perimeter of the East Ramp. Each well point shall be completed with 10 feet of screen. The screen of the upper well point shall extend from 2-4 feet above, to 6-8 feet below the water table. However, there must be at least a two foot seal above this screen. Therefore, the top of the screen will be no closer to the ground surface than 2 feet. The lower screen shall extend from approximately 15 to 25 feet below the land surface. The actual placement of the screens shall be determined in the field by the on-site geologist on the basis of stratigraphic criteria. The deepest well point of each nest shall be drilled first toa depth of 25 to 30 feet with continuous soil sampling methods to facilitate the definition of site stratigraphy and the collection of representative soil samples. One soil sample shall be collected from each well-nest location and submitted for laboratory analysis of petroleum hydrocarbon, and U.S. Priority Pollutant compounds.

2. Soil borings should be installed adjacent to each of the two storm drainage catch basins and the northeastern and northwestern corners of the Ramp. These borings should be installed with continuous soil sampling methods.

3. Composite soil samples from each of the catch basin borings should be submitted for laboratory analysis of petroleum hydrocarbon, U.S.EPA Priority Pollutants and EP Toxicity (lead).

4. Storm water sampling stations should be established at four manhole points around the northern and southern perimeter of the East Ramp. The invert elevation of the storm drain at these points should be established by survey or by inspection of existing engineering records.

5. Two rounds of samples should be obtained from the storm water sampling stations. One round should be obtained immediately after an above-freezing precipitation event; the remaining round should be obtained after a dry period of substantial duration. One round of groundwater samples should be obtained from all existing and additional monitoring wells.

6. All water samples should be analyzed for petroleum hydrocarbon, U.S.EPA Priority Pollutant compounds, soluble lead and TOC.

7. Slug tests should be performed on all existing and additional monitoring wells to estimate the hydraulic conductivity of the saturated materials beneath and adjacent to the landfill. The volume displacement method should be utilized to perform these tests.

8. At least five representative soil samples should be collected from the East Ramp soil borings and submitted for laboratory analysis of total organic matter. This information should then be utilized to estimate partitioning coefficients for individual contaminant species.

9. A continuous groundwater level recorder should be installed in a monitoring well adjacent to the southwest corner of the East Ramp. A similar recording device should also be installed in a

earby storm drain. The data from these installations should be combined with local precipitation data and analyzed to evaluate the correlation between precipitation, subdrainage flow and groundwater fluctuations.

In addition to the site-specific recommendations described above it is further recommended that the location coordinates of all new and existing monitor wells be established when the Base grid system is established. It is not known if this system will be established prior to the completion of the Stage 2 study.

6.2 SUMMARY OF RECOMMENDATIONS

The recommendations which have been made as a result of this Stage 1 study at Selfridge ANGB are summarized in Table 6-1.

WESTON

TABLE 6-1

SUMMARY OF RECOMMENDATIONS

Recommendations	Purpose
Site No. 1, Southwest Sanitary Landfill	
1. Install four two-point monitor well nests.*	Assess magnitude and extent of contamination.
2. Sample storm runoff waters.	Assess impact of contamination on runoff water quality.
3. Analyze water samples for Priority Pollutants, petroleum hydrocarbon and leachate parameters.	Characterize site water quality.
4. Perform slug tests on monitoring wells.	Characterization of migration pathways.
Site No. 2, Fire Training Area-2	
1. Install three borings within training area and sample and analyze soils from each boring.	Assess extent and magnitude of soil contamination.
2. Sample storm runoff waters.	Assess impact of contamination on runoff water quality.
3. Sample and analyze groundwater for petroleum hydrocarbons and Priority Pollutant organics.	Characterize groundwater quality.
4. Perform slug tests on monitoring wells.	Characterization of migration pathways.

* Each monitor well nest shall consist of an upper well which intersects the water table and a lower well point completed at a depth of 25 feet. Each monitor well point shall be completed in separate borings with 10 feet of well screen. The top of the screen in the upper monitor well point shall be two feet above the water table. However there must be a minimum two foot seal above the screen. Therefore the top of the screen shall be no closer than two feet to the ground surface.

TABLE 6-1 (Continued)

Recommendations	Purpose
Site No.3, Fire Training Area-1	
1. Install three borings within training area and sample and analyze soils from each boring.	Assess extent and magnitude of soil contamination.
2. Sample and analyze groundwater for petroleum hydrocarbon and Priority Pollutant organics and lead.	Characterize groundwater quality.
Site No. 4, West Ramp	
1. Install four sets of two-point monitor well nests.*	Assess extent and magnitude of contamination.
2. Install ten borings adjacent to catch basins, and sample and analyze soil samples from each boring.	Assess magnitude and extent of soil contamination.
3. Sample storm drainage waters.	Assess impact of contamination on drainage water quality.
4. Sample and analyze water for petroleum hydrocarbon, Priority Pollutant organics and lead.	Characterize site water quality.
5. Perform slug tests on monitoring wells.	Characterization of migration pathways.
6. Establish water level monitoring station.	Characterization of hydrologic regime.

* Each monitor well nest shall consist of an upper well which intersects the water table and a lower well point completed at a depth of 25 feet. Each monitor well point shall be completed in separate borings with 10 feet of well screen. The top of the screen in the upper monitor well point shall be two feet above the water table. However there must be a minimum two foot seal above the screen. Therefore the top of the screen shall be no closer than two feet to the ground surface.

TABLE 6-1 (Continued)

Recommendations	Purpose
7. Sample and analyze for total soil organic matter.	Assess attenuation capacity of soils.
Site No. 5, Tucker Creek Landfill	
1. Install three sets of two-point monitor well nests around eastern and northern perimeter.*	Assess magnitude and extent of groundwater contamination.
2. Install eight borings adjacent to storm drain catch basins and sample and analyze soils from each boring.	Assess magnitude and extent of soil contamination.
3. Sample storm runoff waters.	Assess impact of contamination on runoff water quality.
4. Sample and analyze waters for Priority Pollutants, landfill leachate parameters, TOC and COD.	Characterize site water quality.
5. Perform slug tests on monitoring wells.	Characterization of migration pathways.
Site No. 6, Northwest Landfill	
1. Install three sets of two-point monitoring well nests.*	Assess magnitude and extent of groundwater contamination.
2. Sample storm runoff waters.	Assess impact of contamination on runoff water quality.

* Each monitor well nest shall consist of an upper well which intersects the water table and a lower well point completed at a depth of 25 feet. Each monitor well point shall be completed in separate borings with 10 feet of well screen. The top of the screen in the upper monitor well point shall be two feet above the water table. However there must be a minimum two foot seal above the screen. Therefore the top of the screen shall be no closer than two feet to the ground surface.

TABLE 6-1 (Continued)

Recommendations	Purpose
3. Sample and analyze water for Priority Pollutants, landfill leachate parameters, TOC and COD.	Characterize site runoff waters.
4. Perform slug tests on monitoring wells.	Characterization of migration pathways.
Site No. 7, East Ramp	
1. Install four sets of two-point monitor well nests.*	Assess extent and magnitude of groundwater contamination.
2. Install two borings adjacent to storm drain and sample and analyze soils from each boring.	Assess extent and magnitude of soil contamination.
3. Sample storm runoff waters.	Assess impact of contamination on runoff water quality.
4. Sample and analyze waters for petroleum hydrocarbon, Priority Pollutant organics and lead.	Characterize site water quality.
5. Perform slug tests on monitoring wells.	Characterization of migration pathways.
6. Establish water level monitoring station.	Characterization of hydrologic regime.
7. Sample and analyze for total soil organic matter.	Assess attenuation capacity of soils.

* Each monitor well nest shall consist of an upper well which intersects the water table and a lower well point completed at a depth of 25 feet. Each monitor well point shall be completed in separate borings with 10 feet of well screen. The top of the screen in the upper monitor well point shall be two feet above the water table. However there must be a minimum two foot seal above the screen. Therefore the top of the screen shall be no closer than two feet to the ground surface.

WESTON

REFERENCES

Environmental Control Technology, 1983, Installation Restoration Program Phase I Records Search Selfridge ANGB, Michigan, IRP Phase I Report Prepared for: Detachment 1, Headquarters Michigan Air National Guard, Selfridge ANGB, Michigan

Lilienthal, Richard T., 1978, Stratigraphic Cross-Sections of the Michigan Basin, Michigan Department of Natural Resources, Geological Survey Division, Report of Investigation 19, p. 10

Southeast Michigan Council of Governments, Detroit 1976, Macomb County Area of Particular Concern Inventory, Prepared for National Oceanic and Atmospheric Administration, Rockville, Md., Office of Coastal Zone Management, PB-263 392, PP.3-5

Twenter, F.R. Knutilla, R.L. Cummings, T.R., 1975 Hydrologic Investigations Atlas, Geological Survey, Lansing, Michigan, HA-546

Weston, Roy F. Inc., 1984, Installation Restoration Program Phase II Problem Confirmation and Quantification Presurvey Report Selfridge ANGB, Michigan, IRP Presurvey Report Prepared for: United States Air Force Occupational and Environmental Health Laboratory (OEHL), Brooks Air Force Base, Texas

END

DATE

FILMED

9-88

DTIC